1981 MIDDLE ATLANTIC ARCHAEOLOGY CONFERENCE ABSTRACTS

I. Regional Research in the Middle Atlantic Area

Remote Sensing Applications to the MAAC Site Survey Form.

Jay F. Custer and Ian Wells
University of Delaware

A regional survey on the Appoquinimmink River of southern New Castle County provided data for a test case of the applicability of the data included on the MAAC site form to LANDSAT analysis. A logistical regression technique provided a reliable statistical predictive model for site occurrences. The data used in the analysis can be derived from LANDSAT scenes.

Monocacy Regional Survey: A Comparison of Survey Methods and Some Preliminary Results.

Maureen Kavanaugh

This paper focuses primarily on the utilization of various survey techniques in regional archaeological studies. Three methods were used to gather data on the Monocacy survey: 1) use of reported sites and interview of informants for site locations; 2) systematic aligned sample of transects placed perpendicular to selected drainages; and 3) a random sample of quadrants selected from each of four geomorphological zones. The transect survey was surface survey only; While the quadrant survey used interval test-pitting.

These three methods will be compared for their effectiveness in predicting location sites, number of sites, microenvironmental variables of site locations, and the distribution of different site types throughout the study region. The value of interval test-pitting will also be addressed.

Some results of the survey will be briefly summarized. Settlement patterns through various phases are compared and related to potential resource utilization.

II. Historic Archaeology

Lenape Settlement Patterns: Villages and Graveyards.

Marshall Becker
West Chester State College

The Lenape (1500-1740) are often mentioned in historic documents but we know surprisingly little about them. Only in the past few years have we been able to understand something about their general settlement patterns and begin to look for areas in which they may have lived. Within the past year we have identified several zones used by these historic Lenape as burial areas and more recently we have gotten some clues as to where we may expect their encampments to be located relative to these burial zones. The use of historic records in this search has saved a great deal of archaeological testing.

Indian Villages of Maryland's Lower Eastern Shore: circa 1660 to 1800.

Thomas E. Davidson
Salisbury State College

During the late 17th and early 18th centuries, relations between the Euro-American colonists and the major Indian groups resident on the Lower Eastern Shore of Maryland were basically peaceful. The Indians inhabited at least ten officially recognized "Indian Towns" whose lands were protected by the proprietary government of Maryland. A combination of documentary and archaeological evidence makes possible the location of all ten of these villages. The geographical positioning of the Indian villages suggests that the official policy of tolerance may have resulted from a desire by the Proprietary government to maintain the fur trade. The material culture of contact period sites in this region is also discussed.

Some Concepts for Intensive Analysis in Contract Archaeology: The Intermediate Level Contract.

Ted Payne and Kenneth J. Basalik
Mid-Atlantic Archaeological Research

There is a popular consensus of thought that contract archaeology has not applied sufficient emphasis to research. The deficiency, the authors feel, is in part the result of a failure to recognize research potential in the analysis of the data base, particularly at the intermediate contract level. It is the opinion of the authors that this research potential can and should be realized, despite the limitations that characterize contracts at this level. Analytical concepts useful in the execution of Phase II analyses are discussed and applied to a Phase II data base developed from a late 18th/early 19th century domicile complex. A number of temporal and functional models are constructed for the site and the value of intensive analysis at the Phase II level contract is revealed.

Investigating Pennsylvania's Provincial Frontier: The Archaeology of Fort Loudoun.

Stephen G. Warfel
William Penn Memorial Museum

Prompted by plans to develop and reconstruct the site of Fort Loudoun, a provincial fortification built on the Pennsylvania frontier in 1756, the Archaeology Section of the William Penn Memorial Museum undertook a near total excavation of the fort site during the summer of 1980. This paper provides a synopsis of the project's findings set against a background of historical documentation and previous archaeological work done on the site. A preliminary research design is also set forth which outlines the nature and justification for future archaeological investigations at Fort Loudoun as well as the anthropologically oriented analysis of recovered artifacts.

Making Old Oysters Talk: New Insights On Oyster Usage in Colonial Maryland.

Brett Kent
University of Maryland

Oyster shells from three sites in St. Mary's City dating from ca. 1640-

(Making Oysters Talk, cont.)
1740 were examined to determine the collection methods, habitats being exploited, the intensity of harvesting and the approximate season of usage. The results indicate that the oysters were locally utilized very intensively, principally collected during the spring and taken in shallow waters with muddy-sand bottoms. Variations in shell morphology suggest that the technology of procurement changed with tongs first used in the 1720's. The potential of oyster shell analysis for providing data concerning the human exploitation of and changes in the estuarine environment during the prehistoric and historic periods is discussed.

The Wilmington Boulevard Archaeological Mitigation Program: A Preliminary Report on the Field Work.

Cara L. Wise
Soil Systems, Inc.

Soil Systems, Inc., under contract to the Delaware Department of Transportation, has recently completed excavations on 7 blocks along Front Street, in Wilmington, Delaware. These excavations have revealed a range of archaeological deposits, including sealed 18th and 19th century occupation levels, privies ranging in date from ca. 1800 to ca. 1900, utility trenches, and a variety of structural remains. Of particular interest to this study has been the identification of superimposed occupation levels, often separated by layers of more or less sterile fill. In most cases, predictions based on documentary data regarding the presence or absence of resources have been confirmed. The analysis of the recovered material will focus on functional and socio-economic changes within the project area through time, and will be coordinated with a thorough demographic study of the same area.

The "Roundabout" Road to Watts Mill: Tenancy, Slavery and Milling in 18th Century St. Mary's County, Maryland.

Terrence W. Epperson
Division of Archaeology
Maryland Geographical Survey

Phase I archaeological reconnaissance of a proposed reservoir site on the headwaters of the St. Mary's River resulted in the discovery of twelve prehistoric and historic sites. Phase II testing and National Register evaluation is being conducted at the site of Watts Mill (18ST263), ca. 1765-1817, and part of the adjacent proprietary tenant farm "Roundabout" (18ST254) ca. 1743-1840. The sale of proprietary manors and availability of western land resulted in dramatic depopulation of southern Maryland following the Revolution. At the same time many planters were shifting from tobacco to wheat as their primary staple export while continuing to grow corn for domestic consumption. The sites provide an opportunity to examine the impact of these changes in the county uplands and compare the cultural patterns and interactions of the mill owners, tenants and slaves who lived in close proximity to one another.

Putting the Site Into Context: The Archaeology of Land and Yardscape.

Garry W. Stone
St. Mary's City Commission

Archaeological sites comprise more than buildings and pot sherds. The environment surrounding structures was modified by the occupants according to their needs, cultural traditions and perceptions of order and space. By examining this aspect of the archaeological record, it is possible to understand the site as a complete entity and to comprehend more fully the changing nature of past social systems. In this paper, the role of archaeology in understanding this total "built environment" is considered, and examples of land and yardscape studies are discussed.

"Among My Other Losses": Patterns of Material Culture in an Early 18th Century Manor House.

Alice Guerrant
Delaware Bureau of Archaeology

The inventory made of planter Robert Carter's estate could not describe the material things that disappeared in the fire that destroyed his mansion. The study of artifact distributions from the ruins of the early 18th century manor house at Corotoman in Lancaster County, Virginia, has identified patterns of small object use on which interpretations of room function and lifeways within the house can be based. The material objects excavated from the ruins of Carter's house and those recorded in his estate inventories are compared to other Lancaster County room-by-room inventories to reveal patterns of room and object use at various income levels in this local community. The widest range of cultural alternatives lay open to Robert Carter and men of his social and economic status. The choices evident in Carter's house are considered a measure of the range of alternatives and the direction of cultural change.

Studying Site Patterns Without Excavation.

Alexander H. Morrison, II
St. Mary's City Commission

Surface collection and related reconnaissance methods traditionally have been used to locate and identify archaeological sites. Often, however, the information which site surveys produce has not been utilized to its fullest potential. Using data from two areas in St. Mary's City, Maryland, this paper will demonstrate the ways in which surface surveys can be used as an efficient means of determining the approximate spatial dimensions of archaeological sites. It will also discuss how these patterns can vary as a result of the duration, complexity and nature of a site's occupational history and use.

Exploring Seventeenth Century Spatial Organization and Use: A Prospectus.

Henry M. Miller
St. Mary's City Commission

The spatial aspects of colonial sites in the Middle Atlantic area have received scant attention in the past. In this paper, the research strategy to be used to investigate this subject in Maryland's 17th-century

(Spatial Organization and Use, cont.)
village will be outlined and the results of preliminary test excavations in the area will be discussed.

III. General Session

The Excavation of the Stadt Huys Block: Methods and Procedures.

Diana Rockman
New York University

As more and more archaeologists are beginning to discuss urban areas, the processes involved in background preparation and field methodology are beginning to be of broader interest within the field. The excavation of the Stadt Huys Block in the Wall Street district in New York City provides an example of the process of urban archaeology in one of the most urban areas of the world. The methods and procedures used in this project resulted in the excavation of the only known remains of Dutch New Amsterdam which have ever been excavated, as well as extensive deposits and features from English colonial and 19th century New York City.

Site Losses Not Federally Covered: A Plan For Doing Something About Them.

Howard A. MacCord

Federal laws control the few sites found on lands affected by Federally-funded or licensed projects. These amount to only about 10% of the sites lost annually in each state. The other 90% are on lands exempt from federal law, and the losses are due to erosion, deep plowing, reforestation practices, construction, open-cast mining, and vandalism. Most archaeologists when asked about these losses merely shrug their collective shoulders and whimper that they don't have the funds/time/people to even go look at the lands affected, much less rescue the data.

Aggressive, innovative, and responsive attitudes and programs seem to be the answer. Needed is a "can-do" approach. Several approaches to the problem are:

1. Reduce the amount of time and paperwork committed to jobs now being done, so as to release man-hours and money for other work.
2. Use the willing volunteer in all aspects of the work, training him/her to the standards considered necessary. Volunteers can come from the state's already-organized archaeological society, from local historical societies, and from history-archaeology clubs organized in junior and senior high schools and colleges.
3. Educate local governmental and business leaders as to the value of archaeological data, so that they will support local and state funding of surveys and preservation/mitigation efforts. Such educational effort includes inviting the local leaders to visit and help on digs, along with their families. How better to acquaint them with what it is about?

Limited success along these lines has been achieved in Virginia in the past, but increased emphasis on all of these aspects is needed, not only in Virginia but in other states in the Middle Atlantic region.

Towards Effective Management: A Cultural Resource Assessment of Maryland State Police and Division of Correction Properties in Maryland.

L. Daniel Myers
Project Archaeologist
Maryland Historical Trust

In compliance with the 1978 Maryland Board of Public Works Policy Statement, an archaeological reconnaissance and assessment of properties, owned by the Maryland State Police and the Division of Correction, was conducted in the fall of 1980. In all, 10 tract-specific properties (2400 acres), ranging from more than 1000 acres to less than three acres were surveyed, resource presence and potential evaluated, and management recommendations made. This paper summarizes the results of that survey and the legislative mandate on which it was based. The advantages and disadvantages of the tract-specific survey and assessment are discussed in relation to; 1) present legislation, 2) the more tradtional regional or areal survey, and 3) the development of a state-wide, state-sponsered conservation program. As such, it is suggested that a number of priorities now confronting archaeology be re-evaluated and re-oriented towards a management program which focuses on the conservation rather than mitigation of archaeological resources.

A Paleoenvironmental Reconstruction of the Delaware Park Site From an Evaluation of Geologic and Palynologic Data.

Robert G. Doyle & Michelle D. Wheatley-Doyle

Geologic and palynologic studies at the Delaware Park Site near Newark, Delaware, have produced data for a paleoenvironmental reconstruction of the area during a time interval spanning occupation periods at the site. These studies included field and laboratory investigation and aerial photo evaluation. Supporting data for the reconstruction came from indentification and interpretation of pollen recovered from feature debris. Results of the study indicate only minor physical alteration has occurred during the last 18,000 years; stream patterns and ridge formation are controlled by underlying structures of considerable age. Palynologic results are consistant with the presence of a boreal-temperate ecotone.

The Effect of Aeolian Processes on the Late Archaic Component(s) at the Baldwin Site in Anne Arundel County, Maryland.

Joseph M. McNamara
Division of Archaeology
Maryland Geological Survey

A Late Archaic site buried by aeolian deposits was excavated in the Coastal Plain of Anne Arundel County, Maryland. As a possible method of analyzing cultural material from aeolian deposited sites, cumulative frequency curves, and correlation coefficients for artifact counts to weights per level were computed to determine if strong correlations between the two exist. Through a comparison of mean values for artifact counts and weights per level, anomalies in the statistical correlations may assist in the interpretation of the vertical profile at the site.

Archaeologically Significant Characteristics of Maryland and Pennsylvania Metarhyolites.

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The metarhyolites from a relatively small geographic area in Maryland and Pennsylvania enjoyed prolonged and widespread cultural utilization during prehistoric times in the Middle Atlantic Region of the eastern United States. Beyond being a marker for helping to trace settlement movements, a number of physical characteristics of this rock type have the potential to aid in: 1) environmental reconstructions and interpreting the depositional history of specific site areas, 2) separating cultural components within mixed plowzone/surface sites, 3) documentation of the reuse of previously discarded artifacts, and 4) the detection of metarhyolite artifacts in survey and excavation situations through the use of a standard metal detector. The rate at which metarhyolites weather and their chemical and mineralogical compositions are the characteristics significant in the discussion of the above items.

IV. New Directions In Archaeology

Surface Collection, The Field Method for Investigation of Skunk Hollow, A 19th Century Free Black Community in Rural New Jersey.

Joan H. Geismar
Columbia University

A controlled collection of artifacts located on the surface in and around 21 structural features at Skunk Hollow, the ruins of a 19th century community of rural free blacks in New Jersey, has provided data for an intra-site comparative analysis. Archaeological investigation of this 28 acre community site was accomplished in a short time, with a small crew, with minimal site disturbance. Using a systematic surface collection as the field method, it was possible to identify feature function and determine chronology; status differences were also investigated, and economic ranking within the community, and its shift over time, were indicated. Given problem orientations and field situations comparable to those at Skunk Hollow, this field method is optimal for archaeological investigation while maintaining the integrity of a site.

An Ecologically Based Model for Fairfax County, Virginia Prehistory

Michael Johnson

Though many Middle Atlantic Archeologists consider Carbone (1976) and Dent (1979) as definitive works on the ecological context for regional models about prehistory, they continue to use the outmoded Paleo, Archaic, Woodland (P.A.W.) structure to describe cultural periods. This paper represents an attempt to make a clean break with the P.A.W. trinity. Carbone and Dent's ecological periods are used as the framework for a new model for the prehistory of Fairfax County, Virginia. The purpose here is to demonstrate increased flexibility, simplicity, and clarity in dealing with cultural adaptation, even on such a small scale as one

(Fairfax County, Virginia Prehistory, cont.)
historic county of less than 500 square kilometers. Additionally, the analyses serve as the basic model for a cultural resource management program and, therefore, are designed to serve lay readers who generally are confused by the P.A.W. trinity.

Processual Theory and Archaeological Patterns: The Search for "Structure" in Historic and Prehistoric Archaeology.

Russell G. Handsman
American Indian Archaeological Institute

It has now been more than one decade since Middle Atlantic archaeologists came to the realization that the New Archaeology had left them behind, attempting to resolve issues in regional chronology which were clearly not relevant to the study and interpretation of past behavior. Now that we have all labored to transform our research into anthropology, and have been as successful as our colleagues in the rest of America, it is becoming apparent that most of us are still mistaken about the process through which knowledge of any past is created.

The substitution of a theory of culture as adaptation for a theory of ordering, reflected in the appearance of settlement archaeology and predictive modeling in the Middle Atlantic, is not as significant a theoretical contribution as we have come to believe. In fact, since settlement archaeology continues to be atheoretical, the supposed revolution in Middle Atlantic archaeology was never alive. Archaeologists are no closer, after a decade of intensive searching, to the illusive behavioral process than we were before. So the ontological shift from a record as strata to a record as activities has not lead to systematic interpretation but simply a second level of modern descriptions.

The problem, one situated inside of all American archaeology, is that archaeologists continue to misunderstand what the role of theory ought to be in archaeological practice. Theory cannot be constructed from nor isolated within a contemporary set of patternings; rather the recognition, analysis, and interpretation of patterns must always be imbedded within some theoretical orientation. As Binford (1980:4) recently summarized:

> The archaeological record is at best a static pattern of associations and covariations among things distributed in space. Giving meaning to these contemporary patterns is dependent upon an understanding of the process which operated to bring such patterning into existence. Thus, in order to carry out the task of the archaeologist, we must have a sophisticated knowledge and understanding of the dynamics of cultural adaptations, for it is from such dynamics that the statics which we observe arise.

Settlement archaeology has no relationship to the behavioral processes of adaptation; it simply represents a different level of description which archaeologists have decided to impose upon the archaeological record. Thus all Middle Atlantic archaeology continues to be mistaken since it has assigned analytical priority to the isolation of either settlement components, settlement patterns, or subsistence-settlement systems.

Such an analytical strategy is clearly insufficient since it does not encompass its units, the patterns it chooses to "discover", within theories of adaptation. Working from the base provided by Lewis R. Binford's recent adaptive contrast between foraging and collecting (a con-

(Processual Theory and Archaeological Patterns, cont.)
trast of incredible significance to the Middle Atlantic area) as well as the behavioral principle of redundancy, it is possible to "rethink" the archaeological record of the Middle Atlantic as a reflection of economic and ecological principles. The interaction of these principles will be reflected in the archaeological record in a variety of "maps", none of which are currently part of modern archaeologists' conceptual systems.

Units and concepts such as aggregations, internal structures, coarse and fine-grained patternings, and non-sites should replace the now traditional terminology of settlement archaeology. While the realization that Middle Atlantic archaeology continues to be theoretically bankrupt is just appearing, it is possible to trace the necessary relationships between theories of behavioral processes and archaeological patterns. Based upon current research at the American Indian Archaeological Institute, two case studies (one prehistoric and one historic) are summarized which begin with a redefinition of the role of theory in Middle Atlantic archaeology. Each of these examples implies that settlement archaeology is dead (or ought to be), that the search for "cultural" processes can continue within a new theoretical framework, and that analytical concepts such as occupation floors or settlement types have no relevance to our search for behavioral meaning. Ultimately these studies also reveal that the boundary between prehistoric and historic archaeology is completely artificial at the level of social and economic process, while epistemologically valid at the level of a cultural history of separations. By working through the implications situated inside of anthropological theory as well as solving the new problems which arise from this perspective, Middle Atlantic archaeology will once again be viable.

Archaeological Research Potential in the Mid-Atlantic Region.

Stephen M. Perlman
Virginia Commonwealth University

The Middle Atlantic provides a research region filled with potential. While most work has been within the paradigms of culture history or environmental determinism, Mid-Atlantic research need not be limited to these. First, culture history is only part of any research program, and second, environmental determinism probably does not work as an explanatory mechanism in this region. Hunter-gatherers, in particular, lived in a rich environment; one capable of permitting social choices rather than a predetermined outcome. This paper will focus on hunter-gatherer research in the Middle Atlantic but also conclude that similar potential exists for other research interests, including 20th century archaeology and modern material culture studies.

Site and Society: A Polite Assault on the "Gardner Method".

L. Daniel Mouer and Robin L. Ryder

The ascendency of Dr. William Gardner to the role of Guru of Middle Atlantic Archaeology has had a tonic effect in the area. It has not been without side effects of a less desireable sort, however. To encounter the recent penchant for transecting the landscape and dividing prehistory into huge periods whose settlement patterns can be explained by reference to a checklist of environmental variables, the authors offer the hope of social archaeology. The role and nature of social models are discussed.

(Site and Society: A Polite Assault, cont.)
Social "costs" are judged relative to energy costs in determining locations of activities. Finally, a plea is proferred: "ecologically" oriented archaeologists might bone up to autecology, society might be put back into social science and we all might be saved from the potential trivia of stream rank, slope and aspect.

A Preliminary Report on the Utility of the Multispectral Scanner Aboard Landsat to Archaeological Surveying in Maryland.

K.-Peter Lade
Salisbury State College

A new technique is suggested for the monitoring of management areas and archaeological surveying in the state of Maryland. Through the use of a publicly available set of algorithms (Astep II) accessible to all the State Colleges and Universities and available to the Dept. of State Planning and other state agencies, it is possible to classify and analyze the spectral characteristics of digitized data from orbiting Landsat satellites. Recent work conducted at Salisbury State College applying this technique to selected study areas is reported on here. The results are discussed and compared to other sources of data including U-2 overflight imagery and low-level aerial photography.

Stewart

THE EFFECT OF AEOLIAN PROCESSES ON THE LATE ARCHAIC COMPONENT(S) AT THE BALDWIN SITE IN ANNE ARUNDEL COUNTY, MARYLAND.

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Maryland Geological Survey

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March 1981

Abstract: A Late Archaic site buried by aeolian deposits was excavated in the Coastal Plain of Anne Arundel County, Maryland. As a possible method of analyzing cultural material from aeolian deposited sites, cumulative frequency curves and correlation coefficients for artifact counts to weights per level were computed to determine if strong correlations between the two exist. Through a comparison of mean values for artifact counts and weights per level, anomalies in the statistical correlations may assist in the interpretation of the vertical profile at the site.

Section of the Atlantic Coastal Plain Province (Figure 1). The Coastal Plain which extends from the Fall Line east to the edge of the continental shelf, is underlain by a wedge-shaped mass of unconsolidated sedimentary deposits of Cretaceous to Recent age (Mack 1962: 8). In Maryland, the Western Shore part of the Embayed Section, is bordered by the Fall Line and the Chesapeake Bay and exhibits a range of land surfaces from the rolling upland to floodplains and tidal marshes. The topography has been primarily modified by the effects of a changing hydrological system.

The Baldwin site, 18 AN 55, is below the confluence of the Big and Little Patuxent Rivers just south of the intersection of MD Rte 450 and US Rte 3 (Figure 2). The site is situated on a bluff 80' above the confluence of an unnamed stream and the Patuxent River. On the "Geologic Map of Anne Arundel County", the upland area is labelled Patuxent River Terraces of Pleistocene age. Dr. Antonio Segovia, geologist at the University of Maryland, interprets the immediate bluff area, i.e. Baldwin, to be, in fact, a levee of the Early Pleistocene Patuxent River.

Soils at the site are classified as a Galestown/Evesboro loamy sand with 0-5% slopes. The soils are characterized as weak, fine to coarse textured, and well to excessively drained. These soils range from very strongly to extremely acidic. Native vegetation associated with these soils is chiefly hardwoods such as oaks and gums, however, most wooded areas now consist of poor stands of Virginia pine (Kirby and Matthews 1973: 25-28).

Site size at Baldwin has been determined by the activities of artifact collectors over the past 60 years who have recovered artifacts from an area some 750m east to west by 335m north to south. Artifacts ranging from Middle Archaic to Late Woodland have been recovered from the surface by these collectors (Sturdy, Thomas, Mayr, Ogle and Rankin). To date, buried artifacts have been reported from only the southwestern portion of the site where the removal of soil for fill first revealed artifacts beneath the plowzone. Subsequent testing by William Longo, a local member of the Archeological Society of Maryland, Inc., established that aboriginal artifacts extended to a depth of 60cm below surface. Other than the areas disturbed by the removal of fill, the southwest portion of the Baldwin site is now in a second generation forest environment. Inspection of aerial photographs from 1938, 1952, 1963, and 1970 show this portion of the site as a cleared agricultural field through 1963. By 1970 the first stages of seral succession can be seen. The predominant on-site vegetation is pine, poison ivy, and briars.

1980 EXCAVATION

The 1980 Maryland field session concentrated on the relatively undisturbed southwest portion of the Baldwin site in an area some 55m by 95m, bordered to the south and west by steep drops in elevation. The strategy of excavation was designed to satisfy the aforementioned goals by using several levels of sampling. The first 2 goals, (1) the identification of the horizontal and vertical limits of buried cultural components and (2) the identification of intrasite patterning of artifacts and activity areas,

Figure 1

Embayed Section of

Maryland Coastal Plain

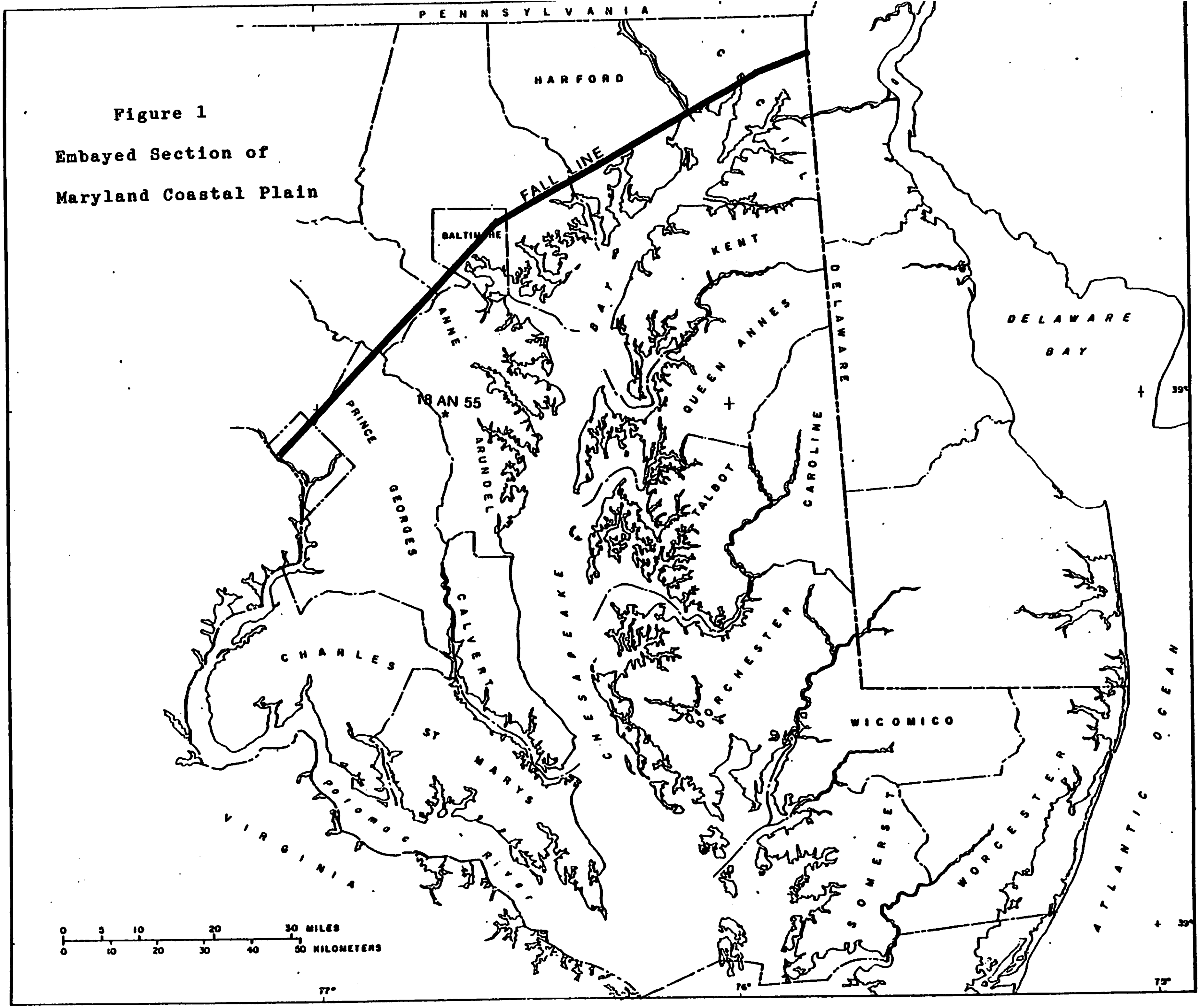
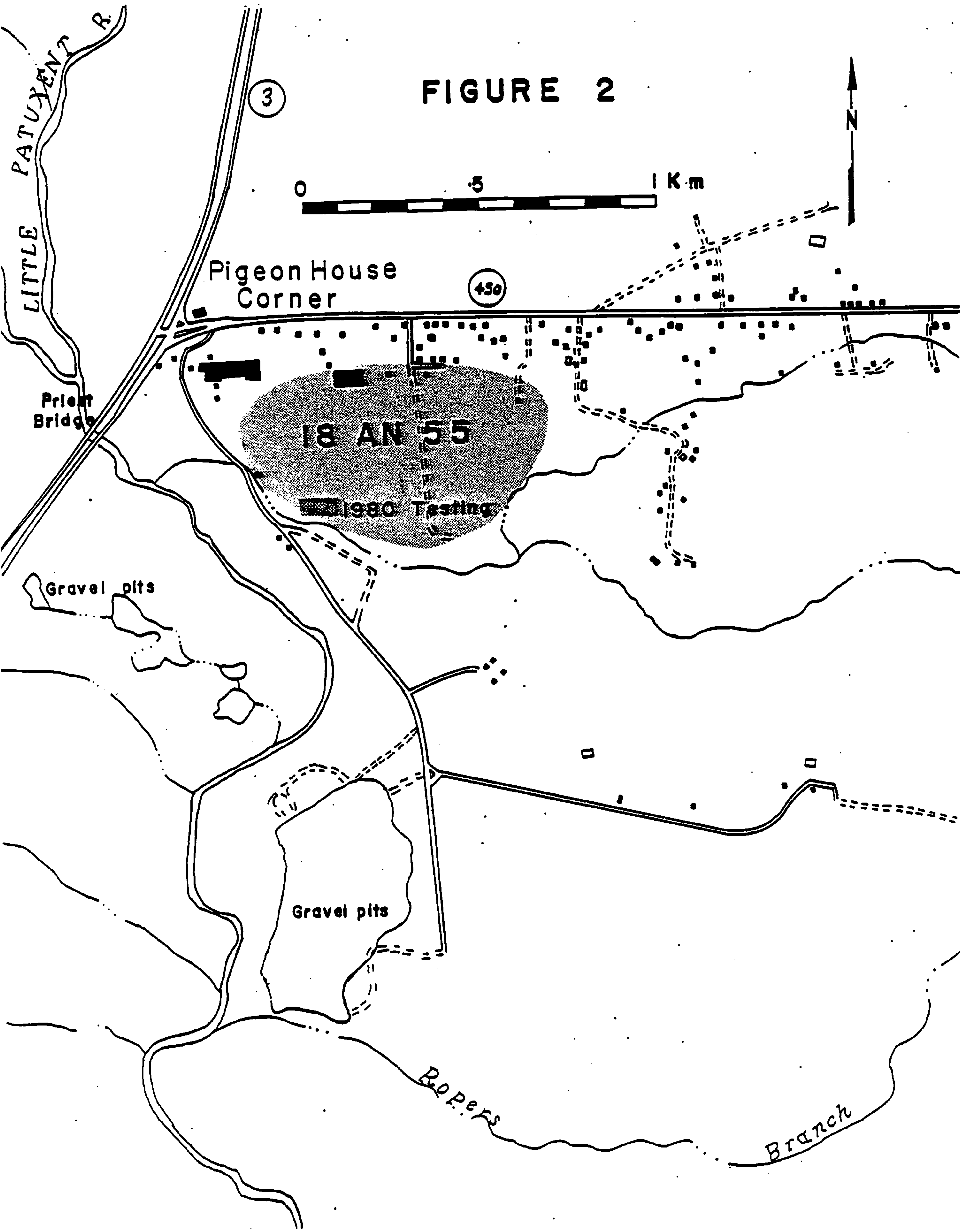


FIGURE 2



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were achieved by utilizing a program of systematic shovel test pits and one meter square test units. The third research goal, the determination of integrity of subsurface cultural deposits, was analyzed by examining the correlation of artifact counts to artifact weights in each arbitrarily excavated 7.5cm level beneath the plowzone. In addition, flotation and soil sampling were utilized to assist in the identification of vertical stratigraphy.

Shovel test pits were used as a means of rapidly identifying areas of artifact concentration. They were 30cm on a side and excavated to a depth of 60-70cm below surface. Shovel test pits were placed every 5m east to west and every 4m north to south. A total of 3,414 artifacts were recovered from 213 shovel test pits (Figure 3). Of this number 576 artifacts are historic and the remaining 2,838 are aboriginal. Figures 4 and 5 reflect the horizontal distribution of historic and aboriginal artifacts. The historic artifacts (Figure 4) are concentrated in the southwesternmost part of the study area and represent a previously unknown late 19th century farmhouse. Aboriginal artifacts, on the other hand, concentrate in several areas (Figure 5) and tend to overlap one another. The central area of prehistoric lithic material is between coordinates W83 and W136. Information pertaining to the distribution of individual artifact types and lithic material is presented in a more detailed report being prepared for publication (McNamara 1981).

Twenty-five 1-meter squares were excavated using 7.5cm arbitrary levels beneath the plowzone. Arbitrary levels were necessitated by the homogenous nature of the sandy soil. Each arbitrary level was divided into four 50cm quadrants and excavated separately. The quadrant method of excavation rather than <u>in situ</u> pedestalling of artifacts was chosen for two reasons: (1) to expedite the rapid completion of units, and (2) its practicality in a sandy soil. Artifacts were bagged and cataloged by quadrant, and flotation samples were extracted from the northeast corner of quadrant #3 from each level. Soil samples were taken from three deep units by Dr. John Foss, agronomist from the University of Maryland, and analyzed for chemical content and particle size at the University of Maryland's soil testing facilities.

A total of 3,555 artifacts were recovered from the twenty-five 1 meter squares. Table 1 provides a breakdown of artifact counts per arbitrary level. A summary description of historic and aboriginal tools, debitage and lithic material will be available in a later article (McNamara 1981).

ANALYSIS

The vertical distribution of cultural material at Baldwin extends from the plowzone to between 60 and 70cm below surface. Cultural material buried to that depth, when located in an upland position, precludes an interpretation of Holocene deposition by alluvial processes. Nor is the Baldwin site in a position where it could be buried by colluvial processes. An aeolian origin for these deposits is supported by the particle size analysis of samples taken from S155W56, S119W56, and S130W123 which indicate that the composition of the soil at Baldwin is over 90% sand (Dr. John Foss, personal communication).

FIGURE 3

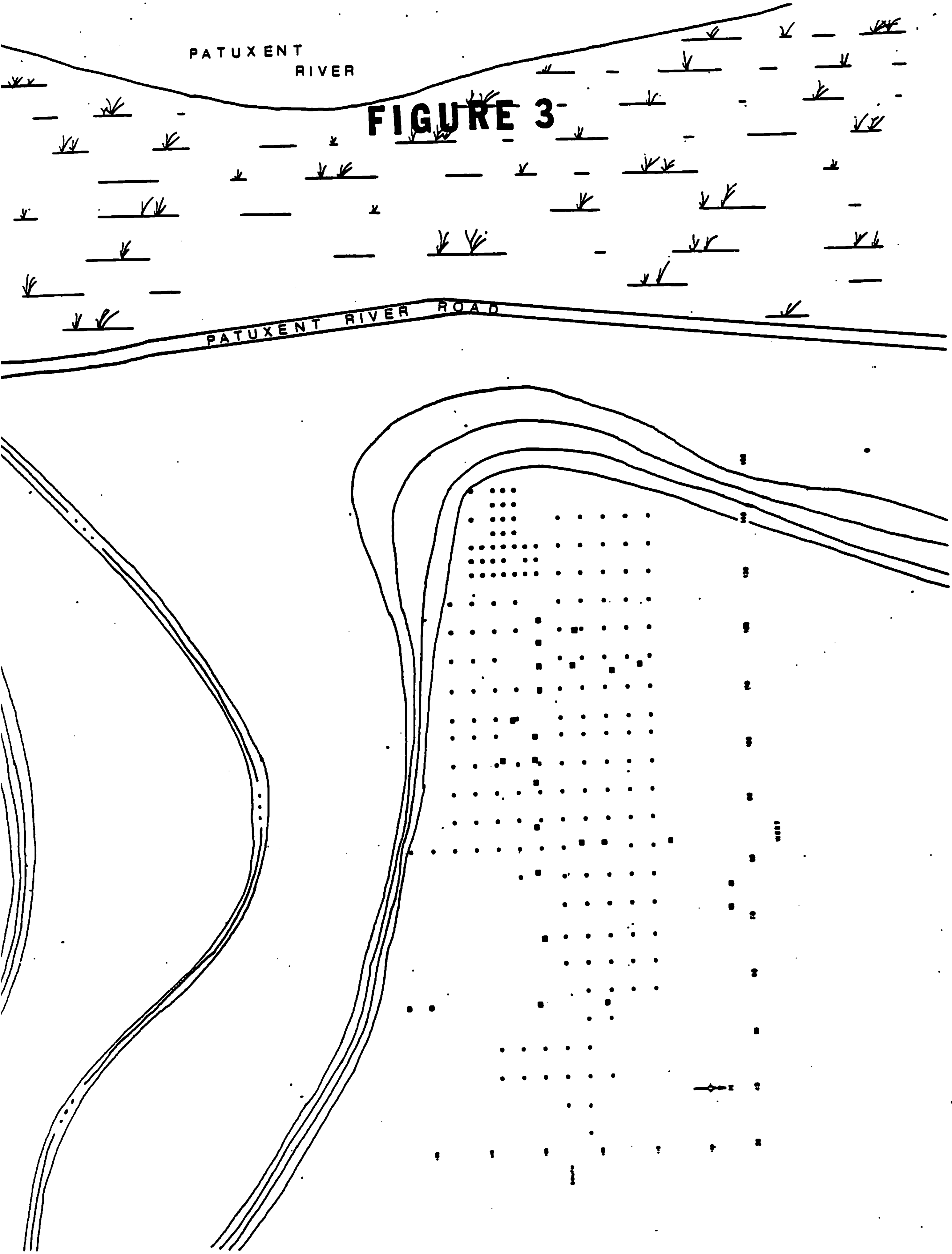

FIGURE 4: HISTORIC ARTIFACT DISTRIBUTION

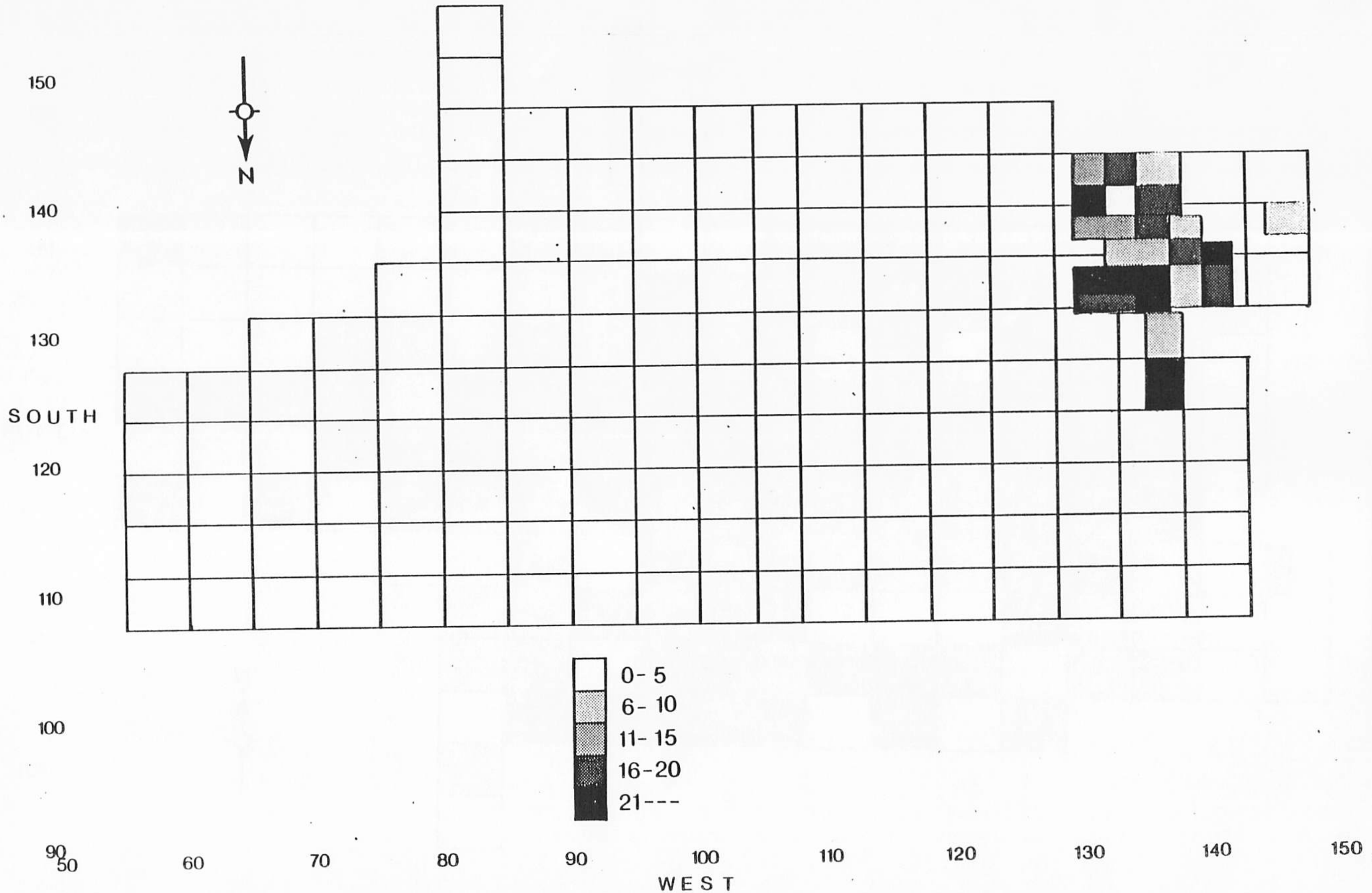

FIGURE 5: ABORIGINAL ARTIFACT DISTRIBUTION

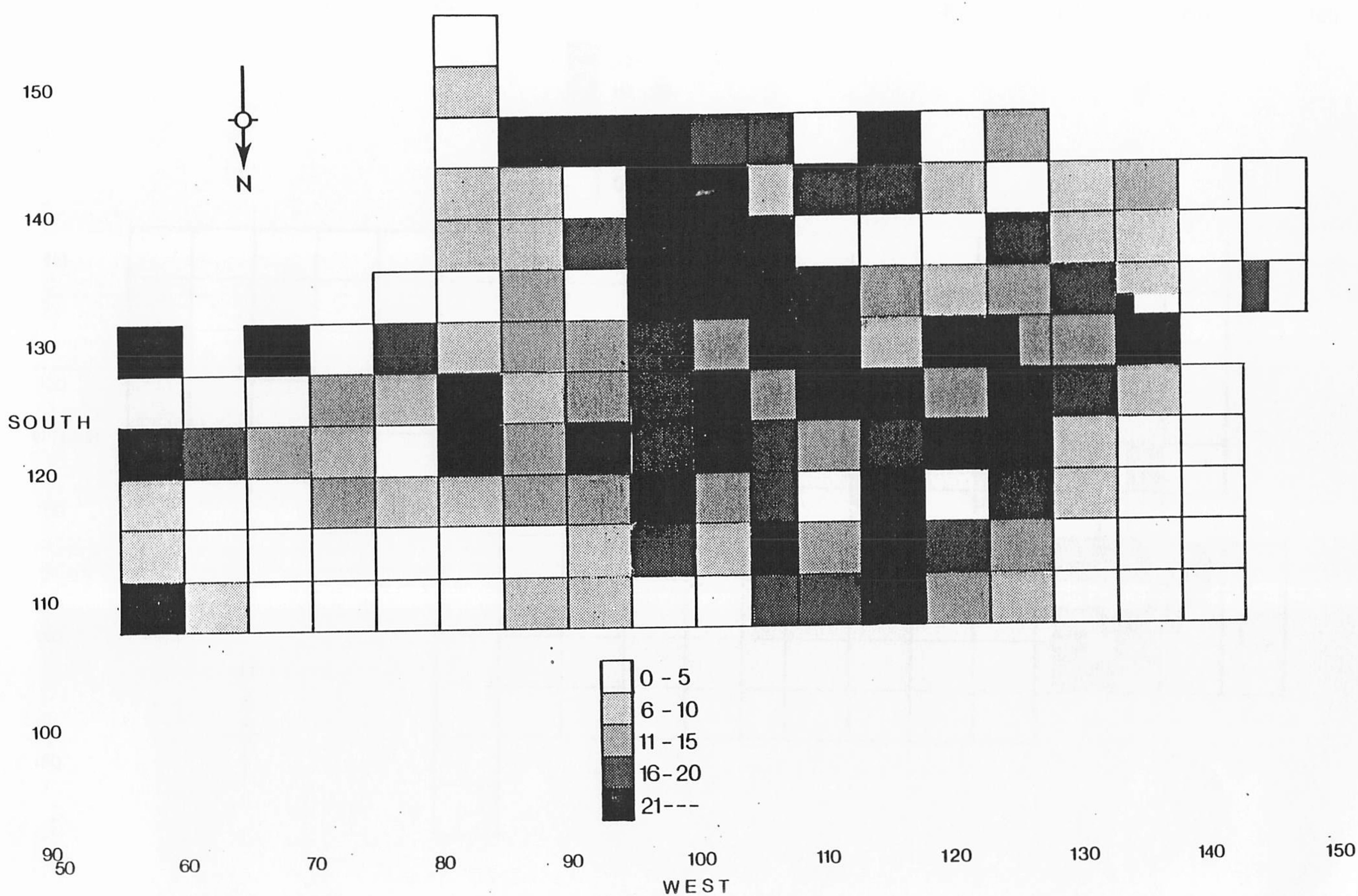

TABLE 1

Artifact Counts By Arbitrary Level

(Fire-Cracked Rock Not Included)

1 meter square	PZ	1	2	3	4	5	6	Totals
S155W56	31	19	16	10	7	3	-	86
S151W56	32	8	2	14	8	7	-	71
S131W56	37	74	85	65	26	12	16	315
S119W56	18	3	11	10	-	-	-	42
S130W68	24	25	19	14	10	2	-	94
S96W72	*	4	24	6	8	4	1	47
S96W76	*	7	5	4	-	-	-	16
S131W79	25	18	16	9	4	-	-	72
S123W84	13	21	43	43	23	7	-	150
S119W84	6	6	5	8	5	2	-	32
S107W84	12	5	7	2	4	-	-	30
S131W87	*	35	56	35	18	6	-	150
S131W95	5	20	41	18	11	2	-	97
S131W99	17	18	11	12	7	1	-	66
S137W99	104	72	113	71	30	1	-	391
S131W103	2	13	12	19	2	-	-	48
S135W106	42	35	42	16	12	3	-	150
S130W111	11	26	28	31	30	-	-	126
S117W114	8	37	47	53	42	32	-	219
S124W115	13	60	34	45	8	-	-	160
S130W115	*	5	8	8	3	-	-	24
S112W115	17	11	14	30	28	-	-	100
S130W119	2*	93	83	48	38	4	-	268
S123W121	140	161	171	92	47	-	-	611
S130W123	1*	37	-	39	14	-	-	91
Totals	558	813	893	702	385	86	17	3,456
Percent	16%	24%	26%	20%	11%	3%	.004%	

*Plowzone not screened

As cautioned by Curry (1980: 9), the same aeolian processes responsible for burying a site can also deflate the site. Therefore, archeological sites situated in a sandy environment may experience a downward settling of artifacts due to the removal of sand from around the artifacts. It must also be recognized that site burial and deflation are not uniform and depend upon any number of variables, a few of which are: wind strength, direction, and on-site vegetation. In summary, cultural deposits in aeolian soils, though buried and seemingly protected, may have in fact moved up or down in the profile.

The excavation and analysis of the one-meter squares was designed to sample diverse areas of the site in hopes of identifying vertical inconsistencies in the material record. Analysis centered around the establishment of a significant correlation between artifact counts and artifact weights per arbitrary 7.5cm levels. Correlation coefficients (r) were used because they show the degree of interdependence between two or more variables such that when one changes so does the other (Clark 1968: 567). It was postulated that anomalies in the archeological record would be identified by weak r values. When computed for the entire site using the total artifact counts to total artifact weights for each level (Table 2), the correlation coefficient or r value was .92, which is significant at the .01 or 99% confidence level (Thomas 1976:508). Judging from such a high r value for the entire site, an examination of the r values for artifact counts to weights from each square by level (Table 2) should be similarly high. As expected, the r value is significant at the .05 or 95% confidence level for the plowzone, level 1, 2, and 4. Levels 3 and 5 fail to show a significant correlation between artifact counts and weights (Table 3). In order to locate the disparity in level 3 and 5, cumulative frequency curves for the plowzone through level 5 were prepared. For each level the frequencies of artifact counts for all the squares were arranged in descending order (Figures 6 - 11). Cumulative frequency curves for the plowzone and levels 1 and 2 (Figures 6, 7, and 8) show artifact weights adhering closely to the curve of artifact counts. In levels 3, 4, and 5 sharp increases of artifact weight at certain points in the curve are present. In level 3, S112W115 and S131W103 (Figure 9) are immediately noticeable for their increases in weight. When these two squares are deleted from the sample for level 3, the r value jumps from .18 to .76 (significant at the .05 level). The difference, which accounts for the reduction in correlation, is attributed to the presence of large utilized cobble fragments in the sample. In level 4, the r value is significant at the .05 level of confidence, however, it is well below those of the plowzone and levels 1 and 2. Figure 10 shows a sharp increase in artifact weights from squares S137W99 and S112W115. Again, split cobbles and core fragments seem to be accounting for a lack of strong correlation. In level 5, the increases in artifact weight is shown in S130W119 (Figure 11). When S130W119 is deleted from the sample, the r value jumps from .002 (almost no correlation) to .92, a very strong correlation. The difference in correlations between the presence and absence of S130W119 in the sample can be observed by a comparison of mean artifact weight between the two. The mean artifact weight for the 4 artifacts in S130W119 is 34.78 grams, whereas, the mean artifact weight for the remaining 82 artifacts in level 5 is .39 grams. This shows that by using cumulative frequency curves, anomalies in the relationship of artifact counts to weights can be quickly located.

CUMULATIVE FREQUENCY CURVES FOR ARTIFACT COUNTS AND WEIGHTS

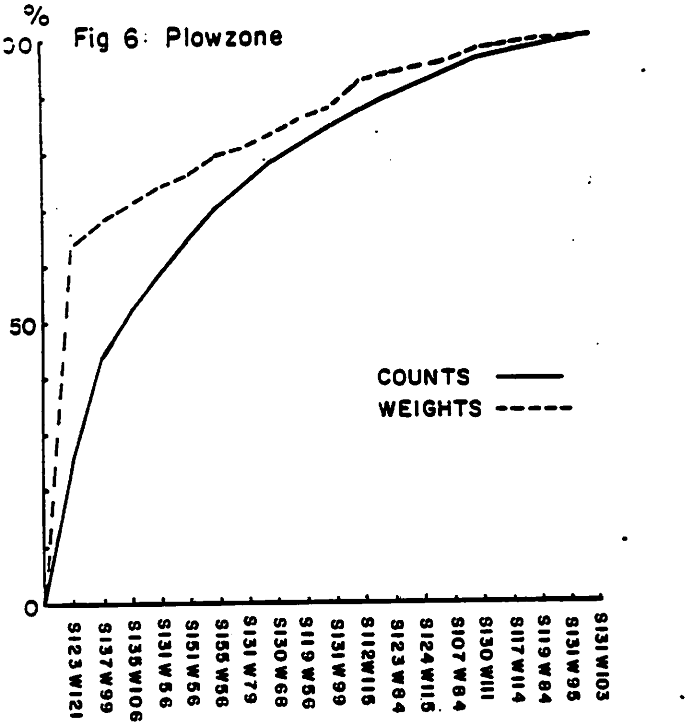

Fig 6: Plowzone

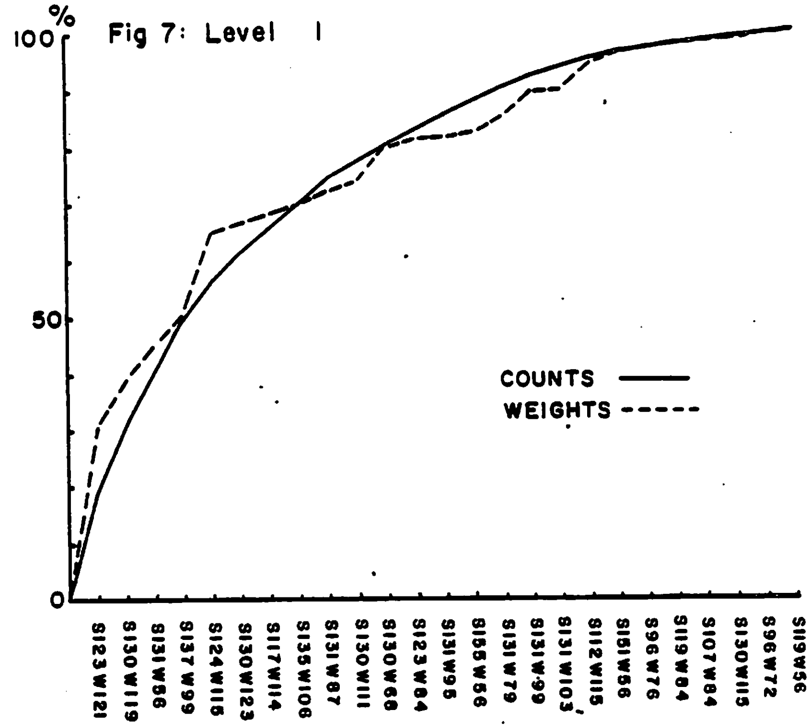

Fig 7: Level 1

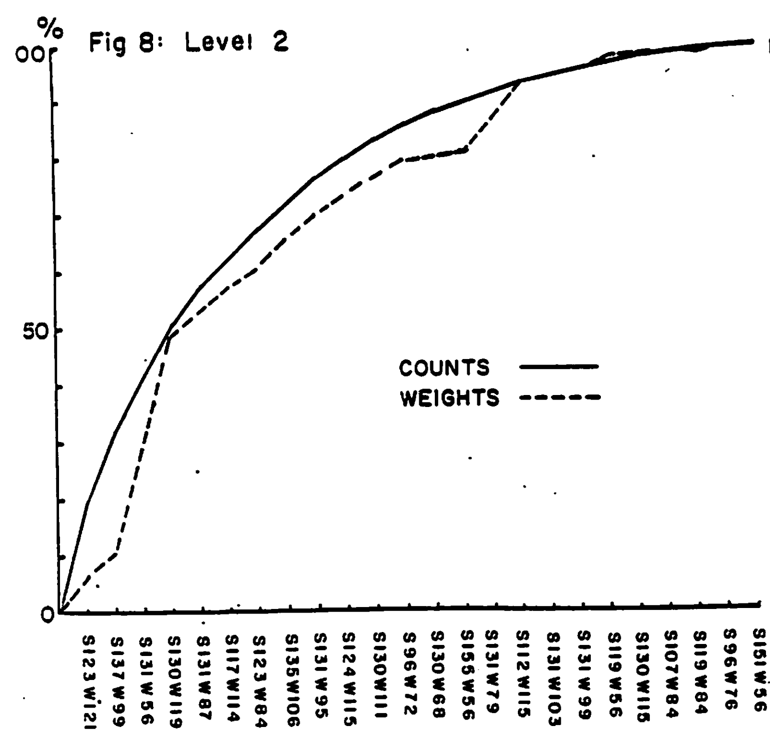

Fig 8: Level 2

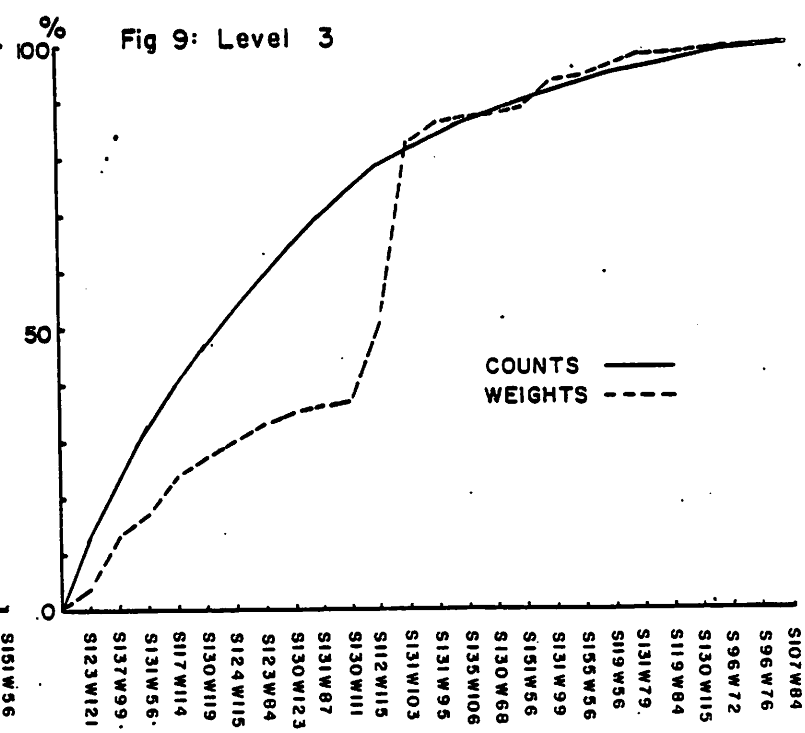

Fig 9: Level 3

CUMULATIVE FREQUENCY CURVES FOR ARTIFACT COUNTS AND WEIGHTS

Fig 10: Level 4

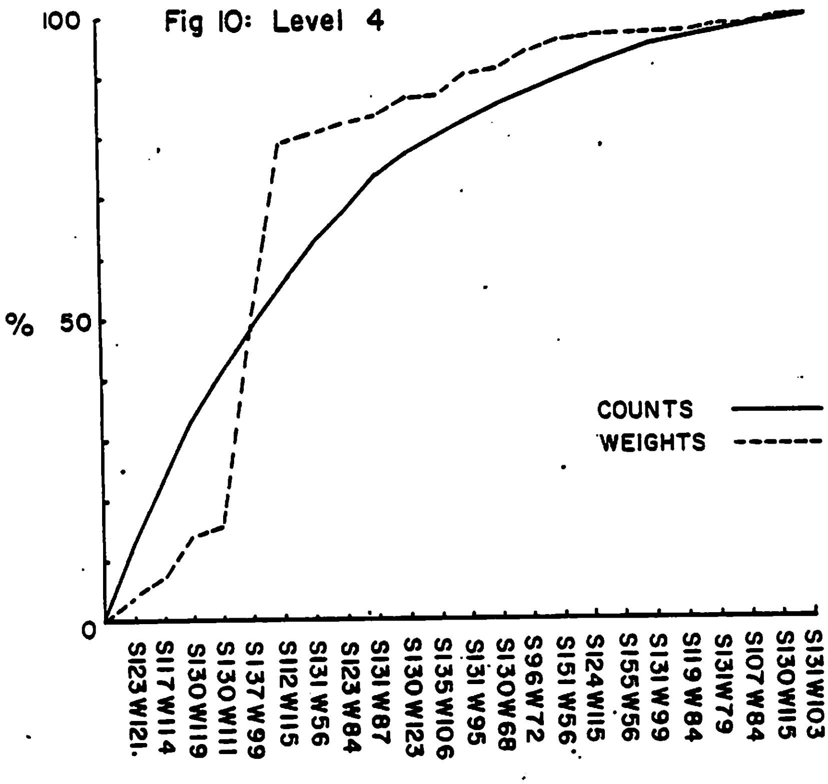

Fig 11: Level 5

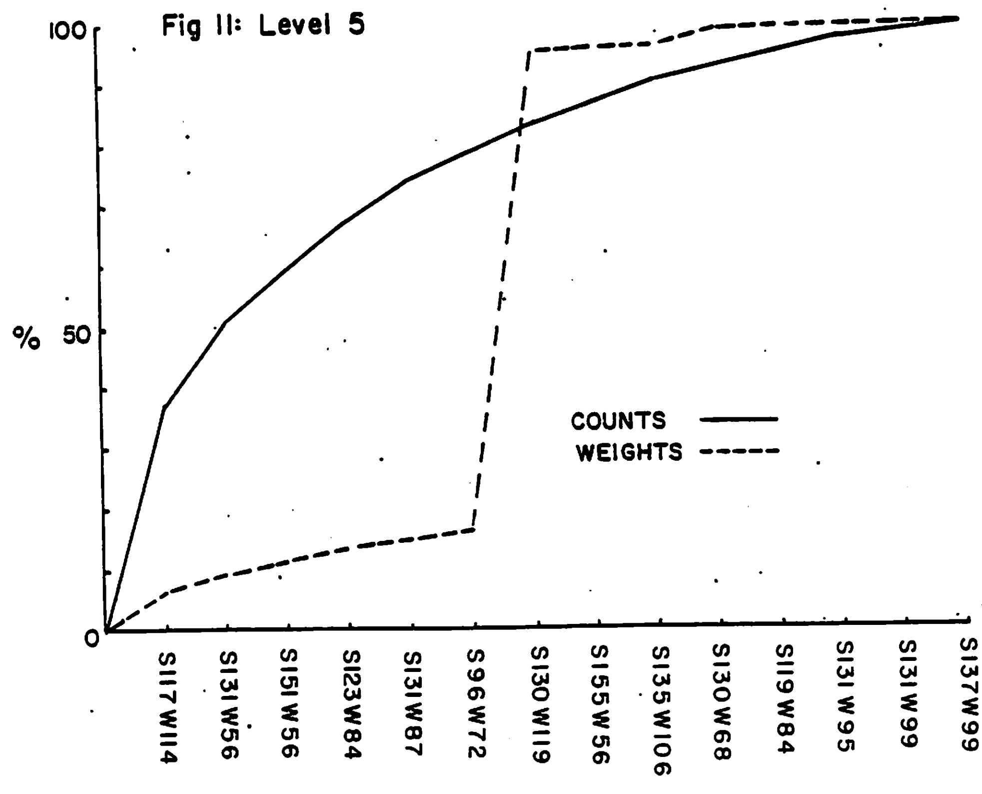

TABLE 2

Artifact Counts (X) and Artifact Weights (Y) Per Level

Squares	PZ X	PZ Y	1 X	1 Y	2 X	2 Y	3 X	3 Y	4 X	4 Y	5 X	5 Y
S155W56	31	53.07	19	10.44	16	12.03	10	3.07	7	1.21	3	1.08
S151W56	32	29.20	8	28.88	2	1.01	14	10.03	8	11.81	7	3.63
S131W56	37	44.24	74	90.47	85	238.13	65	32.19	26	9.23	12	4.58
S119W56	18	39.13	3	2.74	11	29.58	10	17.33	-	-	-	-
S130W68	24	38.96	25	86.41	19	5.81	14	5.60	10	5.00	2	5.00
S 96W72	-	-	4	16.77	24	32.79	6	6.65	8	19.42	4	2.49
S 96W76	-	-	7	5.13	5	15.03	4	1.43	-	-	-	-
S131W79	25	21.68	18	42.22	16	64.78	9	14.66	4	8.43	-	-
S123W84	13	23.91	21	18.89	43	41.62	43	25.89	23	11.47	7	3.72
S119W84	6	17.33	6	14.71	5	.78	8	1.55	5	1.39	2	.24
S107W84	12	14.63	5	2.88	7	3.41	2	2.32	4	.89	-	-
S131W87	-	-	35	32.30	56	62.52	35	12.20	18	7.58	6	2.63
S131W95	5	3.13	20	6.37	41	56.44	18	31.19	11	23.03	2	.74
S137W99	104	72.25	72	78.27	113	54.90	70	70.82	30	222.61	1	.09
S131W99	17	32.11	18	63.14	11	14.12	12	4.48	7	1.02	1	.02
S131W103	2	.46	13	4.51	12	13.08	18	242.16	2	.70	-	-
S135106	42	45.32	35	22.57	42	62.83	16	9.73	12	4.21	3	.61
S130W111	11	36.17	26	25.46	28	44.89	31	12.54	30	10.66	-	-
S117W114	8	12.74	37	24.46	47	61.59	53	56.75	42	19.69	32	11.96
S130W115	-	-	5	6.42	8	7.33	8	2.86	3	6.86	-	-
S124W115	13	13.20	60	208.41	34	43.06	45	25.98	8	4.53	-	-
S112W115	17	66.88	11	66.05	14	93.25	30	106.07	28	198.09	-	-
S130W119	-	-	93	121.98	83	232.77	48	23.16	38	47.31	4	139.11
S123W121	140	957.59	161	445.68	171	81.51	92	31.01	47	27.25	-	-
S130W123	-	-	37	24.53	-	-	39	16.58	14	20.14	-	-

Totals	Levels	X	Y
	PZ	558	1,538.49
	1	813	1,449.69
	2	893	1,273.26
	3	702	1,369.41
	4	385	662.53
	5	86	171.22

TABLE 3

Level	r	n	$\bar{x}$	$\bar{y}$(g)	$\bar{y}/\bar{x}$(g)
PZ	.80*	21	29.32	80.11	2.73
1	.88*	25	32.52	57.99	1.78
2	.56*	24	37.21	53.05	1.42
3	.18 (.76)**	25	28.00 (28)**	54.77 (44.39)**	1.95 (1.58)**
4	.40 (.68)**	23	16.74 (15.57)**	28.81 (11.52)**	1.72 (.69)**
5	.002 (.92)**	14	6.14 (6.31)**	12.23 (2.47)**	1.99 (.39)**

Legend for Table 3

r = correlation coefficient

n = number of squares for which data was computed for given level

$\bar{x}$ = mean artifact counts

$\bar{y}$ = mean artifact weights

$\bar{y}/\bar{x}$ = mean individual artifact weight

* = significant at .05, df = n - 2

** = calculated with the anamolies removed

The cumulative frequency curves also show a tendency in levels 3, 4, and 5 for a lessening in individual artifact weight. This can be seen several ways: (1) by cross-checking the cumulative frequency curves with the values for x and y in Table 2; and (2) by the ratios (listed below) of artifact weight to counts figured from Table 2. The following ratios were computed by tabulating the number of squares which have artifact weights greater than or equal to artifact counts:

Levels	Weights : Counts
PZ	2.8 : 1
1	1.27 : 1
2	1.70 : 1
3	.59 : 1
4	.67 : 1
5	.17 : 1

From this and the cumulative frequency curves it can be seen that the heaviest individual artifact weights correspond to the top levels (PZ, 1, and 2) and by level 3 a clear reduction in artifact weights is apparent. Figure 12 illustrates the cumulative frequency curves of the mean values for artifact counts and weights, and graphically demonstrates the shift in artifact weight with depth. The curves show the frequency of mean artifact weights exceeding the frequencies for artifact counts in the plowzone and levels 1 and 2. In level 3, the curve for mean weights dips under the curve for mean counts, indicating that the mean values for artifact weights in levels 3, 4, and 5 are less than the mean value for artifact counts.

A similar comparison can also be drawn from a cursory examination of the lithic artifact fragments recovered from flotation (Table 4). Correlation coefficients were computed for the entire sample (9 squares) and for each level. The r value for the total artifact counts and weights for the 9 squares flotated is .51 (well below .05 level of confidence). The r values for levels 1 - 5 are as follows:

Level 1 = .41

" 2 = .41

" 3 = .99 (significant at .05)

" 4 = .86 (significant at .05)

" 5 = .80

The low r values in levels 1 and 2 and the low overall r value is the result of disparate values of x and y (cf. Table 4). Cumulative frequency values

Figure 12:

CUMULATIVE FREQUENCY CURVES FOR $\overline{X}$ AND $\overline{Y}$ VALUES

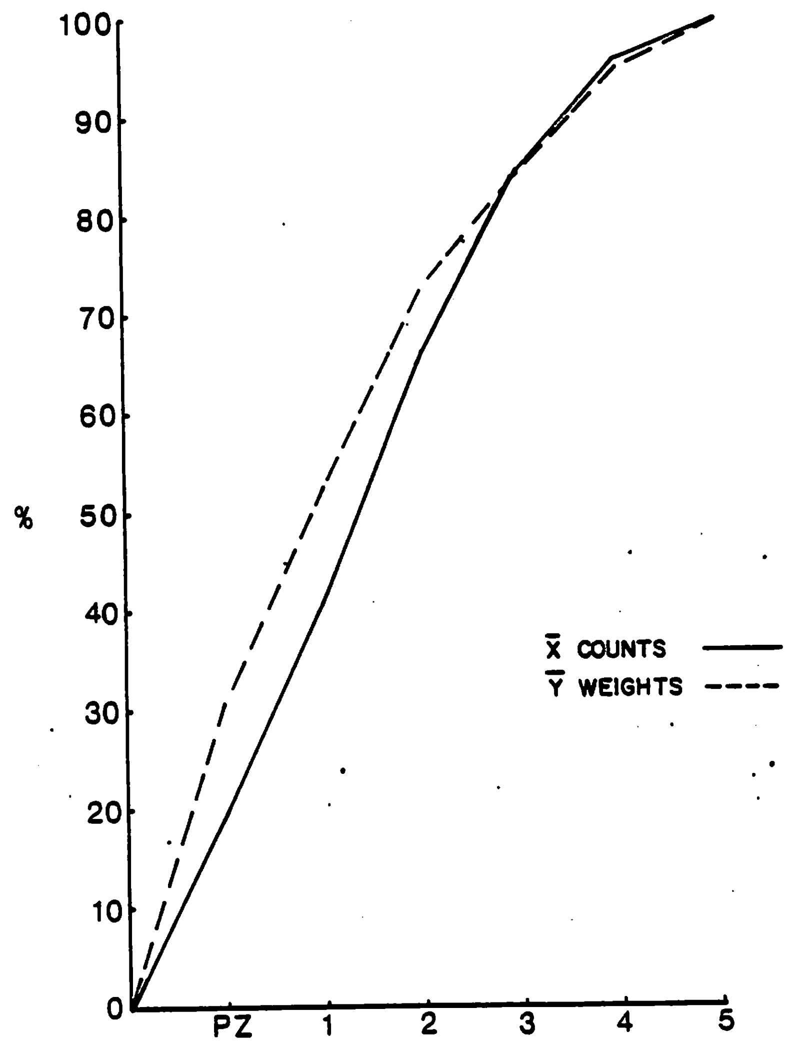

TABLE 4

Lithic Artifact Fragments from Flotation

SQUARE LEVELS	1 X	1 Y	2 X	2 Y	3 X	3 Y	4 X	4 Y	5 X	5 Y	6	TOTAL X	TOTAL Y
S131W56	34	1.01	28	.39	20	.75	-	-	-	-	-	82	2.15
S123W84	12	.14	11	.10	13	.31	2	.06	2	.02	-	40	.63
S131W87	33	1.05	36	.83	21	.41	-	-	0	-	0	90	2.29
S137W99	29	1.15	26	.56	23	.58	8	.56	8	.42	-	94	3.27
S135W106	40	2.50	23	1.87	16	.31	9	.05	0	-	-	88	4.73
S117W114	12	.94	17	.84	21	.71	20	.91	8	1.10	-	78	4.50
S124W115	42	1.94	15	.56	10	.19	13	.53	-	-	-	80	3.22
S130W119	24	3.52	35	.78	15	.22	15	.51	8	1.08	-	97	6.11
S123W121	-	-	36	1.71	72	3.08	20	.82	12	4.89	-	140	10.50
	226	12.25	227	7.64	211	6.56	87	3.44	38	7.51	0	789	37.40g

* *

TABLE 5

Artifact Values from Flotation

Level	r	n	$\bar{x}$	$\bar{y}$	$\bar{y}/\bar{x}$
1	.41	8	28.3	1.53	.050
2	.41	9	25.2	.85	.033
3	.99*	9	23.4	.73	.031
4	.86*	7	12.4	.49	.039
5	.80	5	7.6	1.50	.19

Legend for Table 5

r = correlation coefficient

n = number of squares for which data was compiled for given level

$\bar{x}$ = mean artifact counts

$\bar{y}$ = mean artifact weights

$\bar{y}/\bar{x}$ = mean individual artifact weight

* = significant at .05, df = n - 2

(not included in the report) show artifact weights dipping above and below the x curve in levels 1 and 2, illustrating the weak correlation of artifact counts to weights. Totals of weights and counts per level show a very distinctive decrease of both with depth. Table 5 shows a decrease in mean values of counts and weights (x and y) in levels 1, 2, and 3 but an increase in levels 4 and 5 of artifact weight. Squares S123W121 and S130W119 produced the increase in mean artifact weight for levels 4 and 5 respectively. Both squares have large artifact populations (cf. Tables 1, 2, and 4) and represent areas of heavy lithic activity. The removal of S123W121 and S130W119 considerably lowers the value of the mean individual artifact weight and shows that the increase in $\overline{y}/\overline{x}$ in levels 4 and 5 were skewed by the two areas of heavy activity and do not represent an increasing trend.

CONCLUSIONS

The application of correlation coefficients is a quick and relatively easy means of establishing the strength or weakness of the relationship of one variable to another. In the testing of the association of artifact weights to artifact counts, it was naturally assumed that each artifact has a corresponding weight. As discussed in the preceding section, r values are significant in the uppermost levels but decrease in value with depth. Their drop in value was shown to be largely a result of anomalies present in certain squares which represent a low artifact count associated with a very high artifact weight. Another reason for the drastic effect on the r values by these irregularities, is the coincident decrease in total artifact weights and mean artifact weight per level. The anomalies first appear in level 3 and the mean values for artifact weights dips below the mean values for artifact counts in levels 3, 4, and 5 (cf. Figure 12). The sharp increases of artifact weight in the lower 3 levels of certain squares do not necessarily indicate areas of heavy artifact use, but more aptly represent squares with heavy artifacts. If these were areas of lithic manufacture as appears to be the case in S123W121, an increase in artifact quantity, as well as weight, would be expected. If artifact counts increase proportionately with weights, the effect on r values would not be as magnified.

In summary, the use of correlation coefficients and cumulative frequency curves on data from Baldwin suggest both statistically and graphically that some archeological materials have migrated down in the profile. Table 3 shows that the mean value of artifact counts peak in level 2 and drop off quickly, whereas, the mean value of artifact weights per level is at its highest in the plowzone. Aside from squares S112W115, S131W103, S137W99, and S130W119 where in certain levels mean artifact weight increases, the mean weight of individual artifacts ($\overline{x/y}$) decreases with depth and indicates that the artifacts in movement are equal to or less than 1 gram (Table 3). This trend appears to be uniform across the site and may serve as a caution to others working in the Coastal Zone, that buried cultural deposits may have been subjected to a down-warping of small artifacts in the profile.

Deflation, on the other hand, could not be readily identified from this analysis. If it did play a role in altering the positioning of artifacts at Baldwin, it would have most likely occured in the plowzone and/or levels 1 and 2. Deflation of the plowzone in some of the open areas of

Baldwin, the macro site, is a very real likelihood. However, it is altogether possible that the southwest corner of the site may have served as a catchment basin for blowing sands, thereby preserving it. Future work with buried sites in loosely compacted aeolian soils should attempt to identify deflation by determining: (1) the uniformity of aeolian and cultural deposits, and (2) the stratigraphic positioning of diagnostic artifacts.

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Stewart

THE EFFECT OF AEOLIAN PROCESSES ON THE LATE ARCHAIC COMPONENT(S) AT THE BALDWIN SITE IN ANNE ARUNDEL COUNTY, MARYLAND.

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Presented at

11th Middle Atlantic Archeological Conference

March 1981

Abstract: A Late Archaic site buried by aeolian deposits was excavated in the Coastal Plain of Anne Arundel County, Maryland. As a possible method of analyzing cultural material from aeolian deposited sites, cumulative frequency curves and correlation coefficients for artifact counts to weights per level were computed to determine if strong correlations between the two exist. Through a comparison of mean values for artifact counts and weights per level, anomalies in the statistical correlations may assist in the interpretation of the vertical profile at the site.

THE EFFECT OF AEOLIAN PROCESSES ON THE LATE ARCHAIC COMPONENT(S) AT THE BALDWIN SITE IN ANNE ARUNDEL COUNTY, MARYLAND.

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INTRODUCTION

The focus of this paper is the results of last season's excavations at Baldwin, a Late Archaic site buried by wind-blown sands in the western Coastal Plain of Anne Arundel County, Maryland. This paper, in some respects, is a follow-up to the paper presented by Dennis Curry of the Maryland Geological Survey at last year's Tenth Middle Atlantic Archaeological Conference. At that time Curry presented the results of several cultural resource management surveys funded by the Maryland State Highway Administration, which revealed a recurring pattern of Late Archaic sites buried by aeolian sands. These sites are typified by Brewerton, Bare Island, Poplar Island, and Susquehanna broadspear projectile points. Curry postulated that localized climatic conditions prevalent during the drier Sub-Boreal period caused defoliation which allowed soil erosion and, thus, subsequent deposition of wind-blown sediments responsible for site burial.

The Baldwin Site, one of the seven Late Archaic sites discussed by Curry, became the site of the Tenth Annual Field Session in Maryland Archeology when plans for an industrial park became known late in 1979. The field session was sponsored by the Archeological Society of Maryland, Inc., and was supervised by the Maryland Geological Survey's Division of Archeology with funding assistance from a Heritage Conservation and Recreation Service grant-in-aid administered by the Maryland Historical Trust. Excavations were from 23 May to 1 June 1980 and consisted of one meter squares and a program of systematic shovel test pitting. Goals for the field session were three-fold: (1) to delimit the horizontal and vertical extent of the buried cultural components; (2) identify intrasite patterning of artifacts and activity areas; and (3) to determine the integrity of subsurface cultural deposits. The primary aim of this paper is the discussion of the attempts to satisfy the third goal.

PROJECT LOCATION AND DESCRIPTION

The study area, located in Anne Arundel County, is in the Embayed

Section of the Atlantic Coastal Plain Province (Figure 1). The Coastal Plain which extends from the Fall Line east to the edge of the continental shelf, is underlain by a wedge-shaped mass of unconsolidated sedimentary deposits of Cretaceous to Recent age (Mack 1962: 8). In Maryland, the Western Shore part of the Embayed Section, is bordered by the Fall Line and the Chesapeake Bay and exhibits a range of land surfaces from the rolling upland to floodplains and tidal marshes. The topography has been primarily modified by the effects of a changing hydrological system.

The Baldwin site, 18 AN 55, is below the confluence of the Big and Little Patuxent Rivers just south of the intersection of MD Rte 450 and US Rte 3 (Figure 2). The site is situated on a bluff 80' above the confluence of an unnamed stream and the Patuxent River. On the "Geologic Map of Anne Arundel County", the upland area is labelled Patuxent River Terraces of Pleistocene age. Dr. Antonio Segovia, geologist at the University of Maryland, interprets the immediate bluff area, i.e. Baldwin, to be, in fact, a levee of the Early Pleistocene Patuxent River.

Soils at the site are classified as a Galestown/Evesboro loamy sand with 0-5% slopes. The soils are characterized as weak, fine to coarse textured, and well to excessively drained. These soils range from very strongly to extremely acidic. Native vegetation associated with these soils is chiefly hardwoods such as oaks and gums, however, most wooded areas now consist of poor stands of Virginia pine (Kirby and Matthews 1973: 25-28).

Site size at Baldwin has been determined by the activities of artifact collectors over the past 60 years who have recovered artifacts from an area some 750m east to west by 335m north to south. Artifacts ranging from Middle Archaic to Late Woodland have been recovered from the surface by these collectors (Sturdy, Thomas, Mayr, Ogle and Rankin). To date, buried artifacts have been reported from only the southwestern portion of the site where the removal of soil for fill first revealed artifacts beneath the plowzone. Subsequent testing by William Longo, a local member of the Archeological Society of Maryland, Inc., established that aboriginal artifacts extended to a depth of 60cm below surface. Other than the areas disturbed by the removal of fill, the southwest portion of the Baldwin site is now in a second generation forest environment. Inspection of aerial photographs from 1938, 1952, 1963, and 1970 show this portion of the site as a cleared agricultural field through 1963. By 1970 the first stages of seral succession can be seen. The predominant on-site vegetation is pine, poison ivy, and briars.

1980 EXCAVATION

The 1980 Maryland field session concentrated on the relatively undisturbed southwest portion of the Baldwin site in an area some 55m by 95m, bordered to the south and west by steep drops in elevation. The strategy of excavation was designed to satisfy the aforementioned goals by using several levels of sampling. The first 2 goals, (1) the identification of the horizontal and vertical limits of buried cultural components and (2) the identification of intrasite patterning of artifacts and activity areas,

Stewart

A Reconsideration of Vertical Distribution of Small Debitage at the Baldwin Site (18AN55)

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The purpose of this short paper is to provide a statistical analysis of three cores recovered from the Baldwin Site (18AN55) reported by McNamara (1982a, 1982b, 1981). In the original report on the Baldwin site, McNamara noted that a plot of cumulative flake weight and cumulative numbers of flakes by levels indicated that there was vertical dispersal of small flakes through the Baldwin profile (McNamara 1982a:17; 1981). Movement was suggested for flakes weighing less than 1 gram and the process of aeolian deflation and redeposition was seen as the possible agent of the vertical disruption of artifact assemblages. McNamara (1982a:17-20) also noted that three individual cores could be identified [these mended with flakes?] in three separate excavation units and that each core showed a dispersal among from 3 to 5 arbitrary (7.5 cm thick) levels. Together, these data were interpreted as being evidence for disruption of artifact assemblages and associations at the Baldwin site (McNamara 1982a: 21). The purpose of this paper is to present a more detailed analysis of the vertical distribution of the individual cores to see if additional insights concerning the vertical disruption of artifact assemblages could be generated.

Check conditions for: chi-square
difference of proportion
cumulative percent

As part of the reanalysis of the Baldwin cores, all flakes identified as coming from the three cores noted by McNamara (1982a: 20) were weighed. Summary data on these weights, their mean values, and standard deviations are noted in Table 1 by separate levels for each core.

Because McNamara suggested that smaller flakes were being displaced through the profile, the data from each core was subjected to a series of statistical tests to see if the distribution of flake sizes varied with depth. Frequencies of flakes weighing less than 1 gram and flakes weighing more than 1 gram were analyzed in relation to their vertical distribution by using a chi-square test. The chi-square test was chosen because it would be able to detect a relationship between the numbers of flakes for each size class and the depth of the level in which they were found. For the jasper core in square S117W114 the chi-square test statistic was equal to 3.89 which has a probability value of greater than .05, but less than .75. For the quartzite core from square S131W79, the chi-square test statistic was equal to 0 indicating absolutely no dependent relationship between the variables of flake size and level of deposition. There were insufficient data to apply this test to the chert core from square S137W99. In neither of the two cases where the test could be applied was there any indication that there was a differential distribution of flakes of different sizes with depth of deposition.

A second way of testing to see if there was a differential distribution of small flakes with varied depth was to calculate the mean weight and its standard deviation for all flakes weighing less than 1 gram for each level. These data are included in Table 1. Using these statistics, all possible combinations of levels within each square were compared using the difference-of-mean test. Table 2 lists the resulting test statistics and none are significant; in all cases the probability of occurrence by chance alone exceeds .10 and in many cases exceeds .25. Therefore, the statistical tests indicate that for these three cores, there were no significant differences in the distribution of small debitage by level within a single core's vertical distribution.

A third test of the differential vertical distribution of different sizes of small debitage was to plot the cumulative weight and number of flakes by depth. This method was chosen because McNamara (1982a, 1981) used it, with all flake data from the site, to initially document the possible movement of small artifacts. In the original study, movement of artifacts was seen to be indicated by the fact that the cumulative curve for artifact frequency dipped below the curve for mean weight. Figure 1 shows the same cumulative curves for each of the three cores and in no cases do the curves show the same pattern as that noted by McNamara for the overall curves.

The results of these three tests indicate that although the general conclusion that some vertical displacement of flakes took place at the Baldwin site is correct, it should not necessarily be applied to all areas of the site. In the squares where these three cores were found, there is no indication from the statistical analysis that the small flakes have been significantly displaced through the profile. It should also be noted that the chi-square analysis indicates that the larger flakes weighing more than 1 gram also show no significant variation through the profiles. The last column in Table 1 shows the larger flake weights by level and it can be seen that large flakes from each core are present in most levels where there are also small flakes. This would suggest one of two possible explanations: 1) The depositional context of these cores was such that they were deposited and buried over a long enough period of time so that their vertical displacement, representing a single occupation, ranged up to 25 cm; or 2) Some kind of vertical displacement of artifacts, sufficient to move artifacts up to 15 grams in weight has disturbed the entire profile and none of the associations of artifacts represent single use-periods or depositional events.

In sum, the hypothesis that all of the Baldwin site has been disturbed by aeolian processes such that only small flakes have been displaced is not supported by a statistical analysis of these three cores. However, the contemporaneity of the deposits is not clearly supported by the data either. This is not to say that the deposits are not representative of a single point in time. Rather, it can be stated that the Baldwin site does not have data with sufficiently good context to assess the question of the contemporaneity of the deposits. It is especially important to note this fact so that researchers do not take the Baldwin vertical distribution data and use it to explain away all "anomalous" associations of projectile point styles as examples of "Baldwin-style" displacement.

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- differences in flake sizes could just as easily be reflecting technological differences in deposits as mixing
- check vertical distribution of FCR weights and heaviest artifacts; raw material changes with depth; levels that features occur, etc.

Table 1: Summary Data on Flakes from Cores

Level	#<1.0g	#>1.0 g	Total	Mean<1.0 g	Std.Dev.<1.0 g	Flake Weights>1.0 g
Jasper Core (S117W114)						
1	10	2	12	.23	.26	2.83, 2.50
2	23	2	25	.18	.19	1.18, 1.05
3	22	1	23	.17	.16	2.98
4	22	5	27	.14	.13	4.62, 2.20, 1.07, 1.04, 1.01
5	12	1	13	.13	.14	1.62
Quartzite Core (S131W79)						
1	12	4	16	.34	.28	5.46, 5.21, 4.15, 1.36
2	7	2	9	.27	.14	15.30, 12.92
3	3	1	4	.46	.33	6.84
Chert Core (S137W99)						
1	0	1	1	--	--	3.19
2	9	0	9	.21	.07	----
3	11	1	12	.17	.12	5.46
4	10	0	10	.32	.30	----

Table 2: Difference-of-Proportion Test Statistics Compared by Level

Jasper Core (S117W114)

	1	2	3	4	5
1	----	.625	.750	1.125	1.110
2		----	.200	.800	.833
3			----	.750	1.000
4				----	.500
5					----

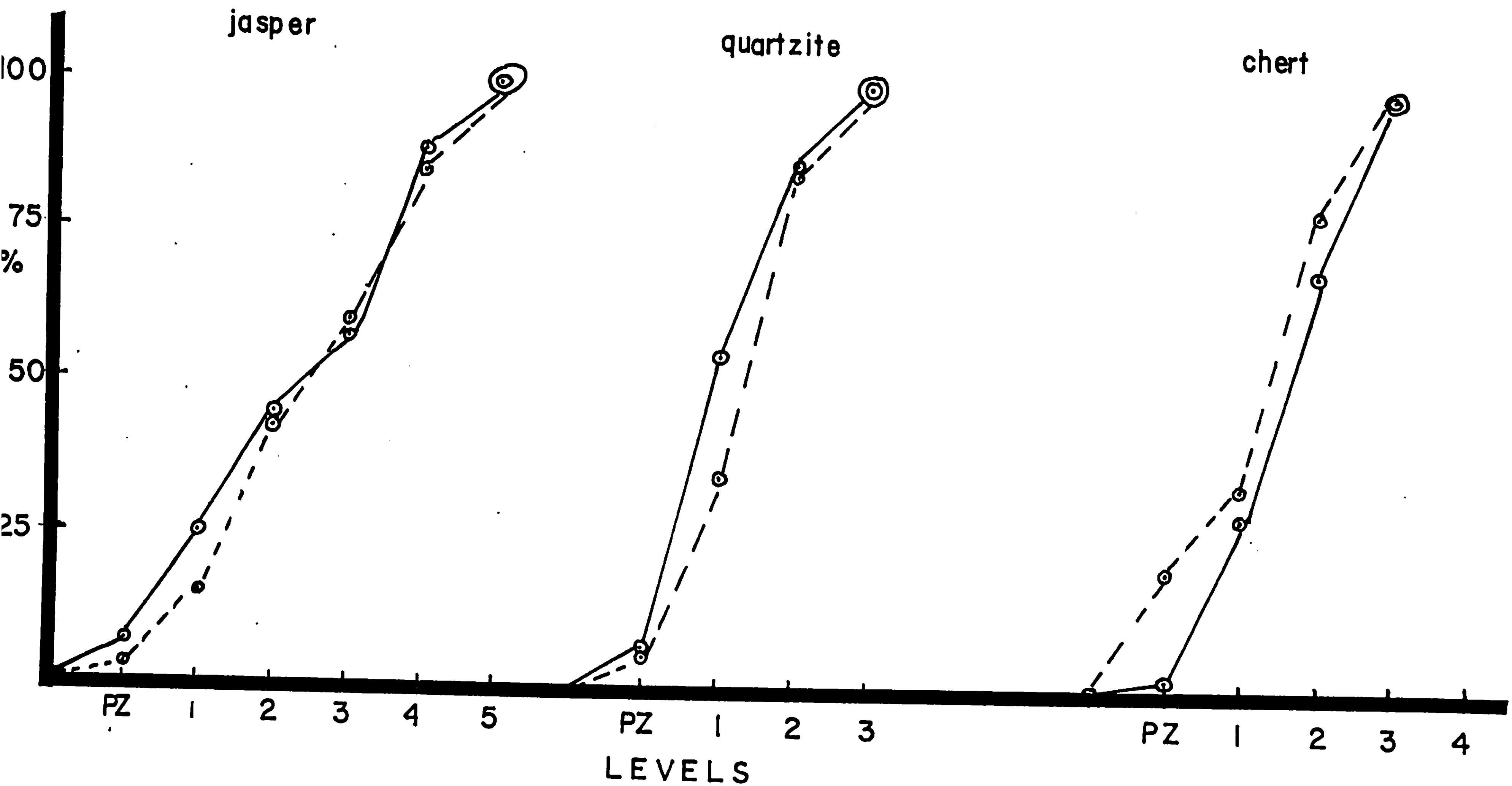
Quartzite Core (S131W79)

	1	2	3
1	----	.786	.585
2		----	.964
3			----

Chert Core (S137W99)

	2	3	4
2	----	.911	1.100
3		----	1.500
4			----

FIGURE I - Cumulative Percent Weight and Flake Count



Stewart

MONOCACY REGIONAL SURVEY: A COMPARISON OF SURVEY METHODS AND SOME PRELIMINARY RESULTS

Maureen Kavanagh
Division of Archeology
Maryland Geological Survey

Presented at

11th Middle Atlantic Archeological Conference

March 1981

Abstract: A three-year intensive archeological survey was conducted in the Monocacy River Region in Frederick and Carroll Counties, Maryland, from January 1978 to November 1980. Three different methods were used to collect site information leading to a predictive model for site location. A comparison of these methods shows that reported sites provide adequate information on micro-environmental variables for site location, while systematic survey allows for estimation of site densities, quantification of micro-environmental variables, and some analysis of site function and distribution through time. Interval test pitting did not effectively increase site recovery. The overall research design should vary depending on the particular focus of the regional survey, be it maximum site recovery, establishment of a predictive model, obtaining new chronological information, or addressing particular questions about settlement systems and resource use.

MONOCACY REGIONAL SURVEY: A COMPARISON OF SURVEY METHODS AND SOME PRELIMINARY RESULTS

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Project Location

The Monocacy River Region is centered in a broad lowland at the western margin of the Maryland Piedmont. The river is formed by the confluence of two streams at the Maryland/Pennsylvania state line, and flows 56 kilometers in a southerly direction into the Potomac. The Monocacy study area, as defined for this project, is bounded by the Potomac River on the south, the first ridge of Catoctin Mountain on the west, the Pennsylvania state line on the north, and the western 3.2 kilometer edge of the Piedmont uplands on the east (Figure 1).

The region is characterized by a limestone and sandstone valley known as the Lancaster-Frederick Lowland. It is bordered by the strongly metamorphosed rocks of the Piedmont uplands to the east and the resistant quartzite and sandstones of the Blue Ridge Province to the west. The Lancaster-Frederick Lowland in Maryland has two principal units: a limestone lowland in the southern part of the valley, and the redbed lowland in the north, consisting of sandstones, shales and siltstones of the Newark group overlying the limestone. The redbeds also extend into the south in part of the valley in a narrow strip between the limestone lowland and the mountains to the west (Vokes and Edwards 1974:66).

Major soil associations in the Monocacy valley conform, in part, to the major geologic units. The major soils of the limestone valley (Duffield, Athol) are well-drained, deep, and fertile; the soils of the red shale and sandstone areas (Penn, Readington) are primarily well-drained but a few pockets of poorly-drained soil occur throughout (Matthews 1960:7). Soils of both the Catoctin Mountain and the Piedmont Plateau are well-drained to excessively-drained, with the exception of some pockets of poorly-drained soils at the base of Catoctin Mountain.

Groundwater and drainage characteristics of the valley indicate plentiful surface and groundwater supplies (Meyer and Beall 1958). The stream system in the valley has a well-developed dendritic pattern, with a number of third, fourth, and fifth order streams flowing into the Monocacy.

Today the valley is characterized by farming, with dairy farming predominant. The largest urbanized area in the region is the city of Frederick with a population of 29,000. While the effects of urbanization on the archeological record have been minimal, farming has accelerated erosion rates in the valley, and defines the ground cover conditions which play an important part in archeological site recovery.

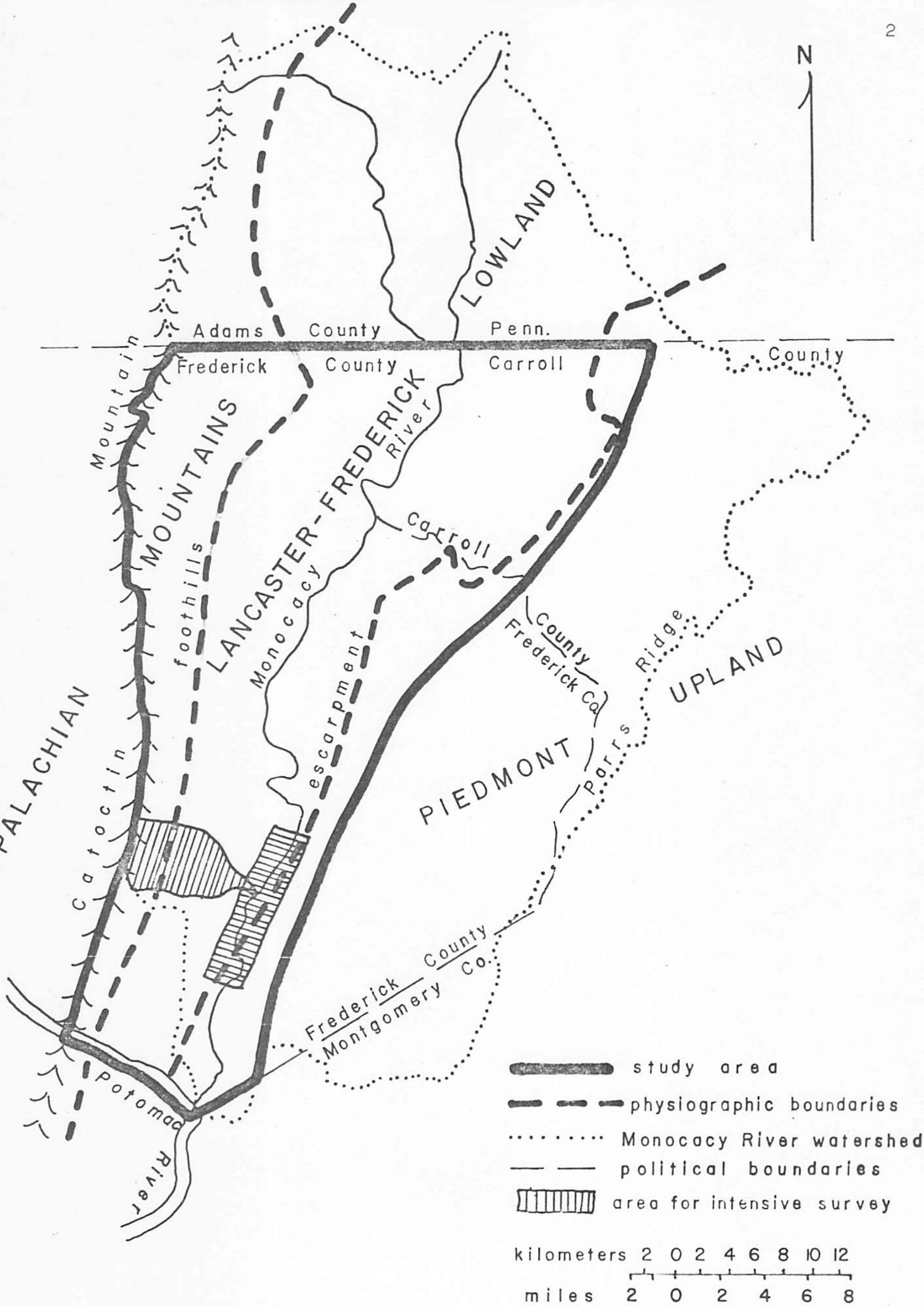

Figure 1. The Monocacy River Region

Archeological Investigations

The current project has been a three-year intensive archeological survey of the Monocacy River Region. Conducted by the Maryland Geological Survey, funding for the project was provided by a Heritage Conservation and Recreation Service Survey and Planning Grant-in-Aid administered by the Maryland Historical Trust, and by grants from Frederick and Carroll counties. The principal investigator for the first two phases of the project was Donald Peck, who worked on the survey from January 1978 to June 1979. Under direction of this author, Phase III investigations have run from July 1979 to November 1980.

The primary goals of the project were threefold: (1) to analyze settlement-subsistence systems via the definition of site function and site distribution through time; (2) to develop and refine the chronology for the research region; and (3) to develop a predictive model for site location primarily as a planning and a cultural resource management tool. This paper will focus on the third goal, that of obtaining a predictive model for site location.

Purposes of the Predictive Model

A predictive model for site location often becomes a mechanistic statement which considers the geomorphology and hydrology of a region to be static factors, and a site to be a simple presence/absence variable within the "environmental setting." The difficulties arise primarily from trying to satisfy multiple goals through a single research strategy. In this particular case there are at least two basic questions the archeologist must deal with:

(1) what are the micro-environmental factors which will best predict the presence of a site---any site---in order for planners and people involved in cultural resource management to make informed decisions regarding priorities for survey?

(2) what is the significance of the function and location of each of these sites in the context of the overall settlement of the region?

In trying to answer the first question, simple mechanistic models are generated, whereas for the second, a long-term research strategy of survey supplemented with extensive testing is required. The Monocacy Survey probably exceeded the first goal but fell somewhat short of the second one. This paper addresses some of the successes, problems, and pitfalls that occur in designing the research strategy, in order to open up discussion on what we hope to accomplish (and how much we realistically can expect to accomplish) through regional surveys.

The Survey Methods

The three phases of the project essentially involved the use of three different survey methods. During the first phase of the project, local avocational archeologists were contacted, and both private and public collections from sites within the region were examined. Locations for reported sites were then verified in the field, and a chronological framework for the cultural phases represented in the valley was developed. Of 180 reported sites, 116 were field checked but only 60 could be located. Peck attributes this to sketchy information, changing field conditions, heavy vegetation, and development. As noted by Peck (1979), the informants' reports of site location varied considerably in reliability.

The second research method involved systematic survey, using a strategy of regularly spaced transects placed perpendicularly to the drainage being examined. Six areas in the Monocacy valley were selected either on the basis of proposed future development or because of little previous knowledge of archeological sites in an area. These six were: two sections of the Monocacy River (one in the lower-center and one in the northern part of the valley), Ballenger Creek watershed, Bennett Creek watershed, Owens Creek watershed, and Big Pipe Creek watershed. Each of these areas was subdivided into transects oriented perpendicularly to the drainage, with each transect measuring 100 meters in width and 3 to 7.3 kilometers in length. The transects extended to the lateral boundaries of the watersheds of the creeks, and extended at least 1.5 kilometers on each side of the river in order to insure that all geomorphological zones near the river would be sampled. Using a table of random numbers to select the first transect in each set, every tenth transect was then chosen for surveying. Each of these transects was walked, and all exposed surfaces were examined for cultural material. Occasionally sites were also recorded which did not actually occur within the transects themselves. Test pitting was not used as part of the survey strategy during Phase II.

This Phase II sample had blocked out 10% of each area for surveying. However, due to heavy vegetation cover and pasture, only a little over one-quarter of the land area within the transects was actually sampled, yielding an effective sampling rate of 2.6% instead of 10%. The transects were completed by one field assistant in about 8 months. Fifty-two sites were located in the transects.

During Phase III additional surveying was done, but a different method was chosen, with four goals in mind: (1) to increase the data base for site location analysis; (2) to include the entire survey area in an unbiased selection process for sampling; (3) to supplement the use of surface survey with interval test-pitting; and (4) to refine the predictive model generated during Phase II, particularly in regard to site densities in different parts of the region and site type and distribution. Phase III design was to place a grid over the study area of quadrants 500 meters to a side, stratify the valley for geomorphological zones, and intensively survey a sample of quadrants from each strata.

The definition of the four geomorphological zones was based on differences in topography, elevation, soil characteristics, and surface water characteristics which influence floral and faunal distributions, and perhaps secondarily, prehistoric site distributions. The foothill zone on the west includes the slope of Catoctin Mountain to the top of the first ridge, a narrow strip adjacent to the mountain (500 meters or less) and all colluvial and alluvial outwash soils from the mountain. In general, this zone is characterized by a high proportion of shallow, excessively-drained soils on steep slopes, shallow to moderately deep well-drained soils on the colluvial and alluvial fans, and pockets of poorly-drained soils at the base of the mountain near the first order stream origins. The second zone, the Piedmont uplands on the east, is distinct from the valley because of its higher elevation, rolling topography, highly-dissected streams, and more shallow-excessively drained soils than the valley floor. The third zone, the river, was defined based on proximity to the Monocacy or the Potomac. Here river terraces, floodplains and bluffs are the principal geomorphological units. Soils are shallow and excessively-drained on bluffs, deep and well-drained on terraces and some floodplains, and poorly-drained on the remainder of the floodplains. The vegetation of the river zone is distinctly more hydrophytic in character than the rest of the study area (Brush et al 1976) and would have provided unique food resources for prehistoric populations. The availability of floodplains for both indigenous plants and later for agriculture would also suggest a possible importance of this particular zone to prehistoric populations. The last zone, the valley floor, in a sense constitutes the "left-overs" after defining the other three. The characteristics of the valley floor include a nearly level topography, dendritic drainage by first to fifth order streams, and generally well-drained soils.

In selecting the survey sample, the entire grid was numbered, and quadrants which showed one-half or more of their area to be disturbed or developed were eliminated (215 of 4296). The remaining quadrants were then renumbered within each zone and, using a table of random numbers, a sample was selected from each zone. Sample frequencies varied for each zone. A 1% sample of the Piedmont uplands (9 quadrants), 1% of the valley floor (22 quadrants), a 2% sample of the foothills (12 quadrants) and a 4% sample of the river (15 quadrants) were taken. The larger sampling of the river zone was based on Phase II results which had shown a great variation in site types and site frequencies in the north, middle, and southern parts of the river zone. At least a 2% sample of all strata had been the projected goal but there was not enough time to accomplish this.

Quadrants were surveyed by field crew walking 30 meters apart, examining all exposed surfaces, and putting in test pits every 30 meters when the surface was obscured by vegetation. The test pits were about 30 by 30 cm and were dug to sterile subsoil or to a depth of about 34-45 cm. The 58 quadrants worked out to a total of 14.5 km^2 surveyed. Good visibility averaged 40%. This better visibility was probably due to the fact that surveying was done primarily in the spring and fall, whereas Phase II survey continued through the summer. Phase III fieldwork was completed in approximately 12.5 person-months. During this phase, 63 prehistoric sites were located, 3 by test-pitting. Ten additional sites were identified outside the survey units based on reports by landowners.

These three methods will be compared as to their effectiveness in predicting micro-environmental variables important for site location, and in answering questions about overall site distribution. Also taking into consideration the practical needs of balancing thoroughness of survey with maximum site recovery, the methods will be compared in terms of "cost-effectiveness".

Results of the Surveys

(1) Micro-environmental Variables

The effectiveness of each method in defining micro-environmental variables which are important in site location can be compared in Table 1. As can be seen from this table, all three methods are fairly equal in picking out distance to a water source, site location 15 meters or less above water, location on slopes of 0-15% (with 33-34% on slopes of 3-8%), and the majority on well-drained to somewhat excessively-drained soils. There is more variation in their predictions about landforms for site locations, and even greater variation in the stream ranks of the nearest water sources. These last two factors, however, are more a product of the sampling strategy.

Table 1

Comparison of Micro-Environmental Factors Important for Site Location

Phases I, II, and III

		Phase I	Phase II	Phase III
(1)	200 m or less from a water source	94.0%	98.0%	93.6%
(2)	15 m or less above water	83.2%	86.0%	90.5%
(3)	landforms:			
	hillslope	38.0%	31.0%	30.1%
	river terrace	22.3%	16.0%	23.8%
	stream terrace	17.5%	16.0%	19.0%
	hilltop	8.4%	23.0%	14.3%
(4)	slopes of 0 - 15%	91.0%	94.0%	92.0%
	slopes of 3 - 8%	34.0%	34.0%	33.3%
(5)	well-drained to somewhat excessively drained soils	88.4%	94.0%	90.5%
(6)	stream rank			
	1	23.6%	37.0%	46.0%
	2	3.9%	18.0%	25.4%
	3	19.7%	14.0%	7.9%
	4	16.9%	.0%	6.3%
	5	.1%	1.0%	.0%
	6 (Monocacy)	32.0%	30.0%	14.3%
	7 (Potomac)	3.4%	.0%	.0%

All three seem equally effective in developing the mechanistic model of site location which all avocational archeologists know intuitively and which professional archeologists seem compelled to prove statistically. But exactly how valuable is this prediction? What does it tell you in the Monocacy valley, where over 80% of the soils are well-drained, that 80% of sites occur on well-drained soils? Unless you can get an idea of how frequently certain variables occur in the universe under examination, selection of them as predictors may be fairly meaningless.

Without attempting to quantify these factors for the entire study area, a lesser goal of quantifying the variables for the quadrants was undertaken. Results from Phase III survey had shown that 75% of sites occurred in areas which had the combination of three micro-environmental variables: location 200 meters or less from water, location on well-drained to excessively-drained soils, and location on slopes of less than 15%. In Table 2, the total percentage of area possessing these three characteristics in combination within the quadrants works out to an average of 36%. Thus, when using random sampling techniques, we do have a means of quantifying these variables in order to determine the value of the chosen predictors.

(2) Site Density Characteristics

An area in which systematic survey can provide valuable information which reported sites cannot is the density of sites within certain parts of the survey area. Estimates from the transect survey showed the middle river area to be highest in site density, the upper Monocacy next, and the southern Monocacy lowest (Table 3). Phase III quadrant surveys showed the foothills and the river zone to be highest in site density, the valley floor next, and the Piedmont uplands lowest (Table 4). This information, as well as some input from locations of reported sites, aided in the development of a map of site densities in the study region, with four categories:

(1) very high density: areas within 200 meters of the central river, three areas along the northern river (Devilbiss, Double Pipe, and Shoemaker), and the mouth of the Monocacy;
(2) high density: areas within 200 meters of the northern section of the Monocacy, within 200 meters of water sources in the foothills, within 200 meters of Israel Creek and 200 meters of the Potomac;
(3) moderate density: areas within 200 meters of the southern Monocacy, and all areas within 200 meters of streams not in high density areas; and
(4) low density: all other areas of the Monocacy region.

(3) Distribution of Site Types

Finally, perhaps the greatest advantage of using a systematic survey technique is that it enables one to address questions about the distribution of different types of sites throughout the region, and their relation to the paleoenvironment and resource utilization. The discussion of this topic takes up the bulk of the report on the project and goes beyond the scope of the current discussion, but the topic is briefly considered here, by looking at the recovery of different site types in each of the research strategies. Tables 5 through 8 show the number of sites from each zone. Rhyolite processing stations, identified and defined by Michael Stewart in the Hagerstown valley, consist of large sites near the base of the Catoctin Mountain (near the sources of rhyolite), characterized by heavy concentrations of large

Table 2

Micro-Environmental Variables Within Quadrants--Phase III

Zone	% < 200 meters from water	% 0-15% slope	% well-drained	% with combination	% combination in light vegetation
River	63%	84%	88%	45%	24%
Piedmont	68	66	85	33	13
Valley	54	93	82	38	17
Foothills	61	69	69	24	6
Average:				36%	16%

Table 3

Phase II

Site Density Estimates

	km^2 surveyed	Number of Sites	Number of Sites/km^2	Percent Light Vegetation Cover and Plowed	Estimated # of sites/km^2
Southern Monocacy	3.33	4	1.20	26%	4.62
Middle Monocacy	1.60	6	3.75	31	12.10
Upper Monocacy	4.20	9	2.14	30	7.13
Ballenger Creek	4.50	9	2.00	33	6.06
Owens Creek	6.15	9	1.46	19	7.70
Bennett Creek	2.30	3	1.30	9	14.49
Big Pipe Creek	7.50	12	1.60	31	5.16

Table 4

Phase III

Site Density Estimates

Environmental Zone	Number of Quadrants	Number of Sites	Number of Sites Per Quadrant	Number of Sites Per Square km	Percent Light Vegetation and Plowed	Estimated # of Sites / km^2
Foothills	12	13	1.08	4.33	16.6%	26.1
Valley Floor	22	20	0.91	3.64	44.6%	8.2
River	15	24	1.60	6.40	44.1%	14.5
Piedmont	9	6	0.67	2.67	36.7%	7.3

Table 5

Types of Prehistoric Sites in Monocacy River Region - Reported Sites

	Villages	Rockshelters	Quarries	Rhyolite Processing Station	Habitation	Ephemeral	Unknown	TOTAL
Piedmont	0	2	0	0	2	0	1	5
River	6	2	0	0	30	3	13	54
Valley	0	0	0	1	12	12	12	37
Foothills	0	3	1	1	9	4	10	28
	6	7	1	2	53	19	36	124

Table 6

Types of Prehistoric Sites in Monocacy River Region Phase II - Within Transects

	Villages	Rockshelters	Quarries	Rhyolite Processing Station	Habitation	Ephemeral	TOTAL
Piedmont	0	0	0	0	0	2	2
River	0	0	0	0	7	12	19
Valley	0	0	0	0	5	21	26
Foothills	0	0	0	0	2	3	5
TOTAL	0	0	0	0	14	38	52

Table 7.

Types of Prehistoric Sites in Monocacy River Region - Phase III

	Villages	Rockshelters	Quarries	Rhyolite Processing Stations	Habitation	Ephemeral	Total
Piedmont	0	0	0	0	2	4	6
River	1	0	0	0	9	14	24
Valley	0	0	1	0	6	13	20
Foothills	0	0	1	1	2	9	13
Total	1	0	2	1	19	40	63

Table 8 Types of Prehistoric Sites in the Monocacy River Region
Totals from All Surveys

	Village	Rockshelter	Quarry	Rhyolite P.S.	Habitation	Ephemeral	Unknown	TOTAL
Piedmont	0	2	0	0	4	7	1	14
River	6	2	0	0	62	49	13	132
Valley	0	0	1	1	30	57	12	101
Foothills	0	3	2	2	14	19	10	50
	6	7	3	3	110	132	36	287

rhyolite flakes, hundreds of rhyolite bifaces and points, and considerable rhyolite debitage. It is hypothesized that they functioned as base stations in the rhyolite procurement process and may also have been the locales of secondary reduction processes. Habitation sites were defined as moderate or low density lithic scatters of moderate size, with a variety of extraction and maintenance tools, frequently with evidence for reoccupation. Ephemeral sites were defined as low density lithic scatters, usually with a small amount of lithic material present, and tools (if present) suggesting primarily hunting and/or extraction activities.

Phase I (reported sites) showed the greatest number of villages and rockshelters. These are relatively rare sites in the Monocacy valley, and thus, a regional survey using a small sampling percentage will not be as effective as a purposive survey in recovering rare sites. Noteworthy from Table 5 is that almost one-half of all reported sites are in the river zone.

In both the transect and quadrant surveys, ephemeral sites outnumber habitation sites by over two to one. This again reflects the fact that the most heavily-occupied sites are recognized and reported, thus tending to skew the overall picture of prehistoric settlement. Even in Phase III the river zone was oversampled in proportion to the others but this survey was most equal in its sampling percentages.

Finally, the best available information on site distribution as represented by a combination of the data from all three phases is presented in Table 8. The small number of quarry sites is probably a function of the boundaries for the regional survey, as Mike Stewart has located a number of rhyolite quarries in the mountain just to the west of Catoctin Ridge. Unquestionably the location and function of many sites in the Monocacy valley are related to the procurement of rhyolite. Over 70% of the lithic material at sites in the valley is rhyolite, with quartz, quartzite, and other minor materials making up the remainder. The scarcity of sites in the Piedmont uplands on the east, and the heavier site densities in the foothills are at least in part related to the use of this lithic material. This is an example of the questions about settlement and resource use which can be addressed using data obtained on a regional basis.

Summary

Systematic surveys have been advocated in the archeological literature for some time, with the most frequently cited examples coming from the western United States (Thomas 1974, Mueller 1975, Bettinger 1977). Unquestionably these methods encounter many problems when transplanted to the Eastern Woodlands, first and foremost of which is the problem of vegetation cover. In the Monocacy survey, approximately 30-40% of the land surface had good visibility. During the third phase the interval test pitting was very unrewarding, locating only three of 63 sites. The question of cost-effectiveness of the survey must be addressed if interval test-pitting is so unsuccessful in site recovery. This probably would have increased somewhat if tests were screened, but at the cost of reducing again by one-half the amount of land which could be covered. At this point, a strategy of using a combination of existing information, a random surveying design examining areas with good visibility, and a purposive testing strategy both within and outside survey units would most effectively fulfill the combined goals which regional survey attempt to satisfy.

The study of reported sites and existing collections provide information on the chronology of the region, the presence of certain rare sites, and the identification of micro-environmental variables important for site location. The systematic survey allows an assessment of site distribution, a quantification of site densities, and quantification, on a small scale, of micro-environmental factors, the effectiveness of which will vary according to the region's overall characteristics. Finally, purposive testing can be used in areas in which vegetation cover is a problem or buried sites might be present. Archeology done on a regional basis provides a large data base from which to study resource use, settlement types, the overall relationship to other regions, and numerous questions regarding chronology as well as settlement-subsistence. Its effectiveness, particularly when done on a long-term basis is unquestionable, but our expectations about the amount of information which can be recovered must be realistic, and emphasis should be placed on the research goal, be it maximum site recovery, obtaining new chronological information, or focusing on a particular question about settlement systems and resource use.

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1981 Middle Atlantic Archaeological Conference

FRIDAY AFTERNOON

1:00 PM - Welcoming Remarks - Peter Lade, Salisbury State College

Regional Research in the Middle Atlantic Area

1:10 PM - Introduction - Howard MacCord, Archaeological Society of Virginia

1:15 PM - Site Survey Form Modifications and Historic Site Supplement - William P. Boyer and Bruce Kiracofe, James Madison University

1:45 PM - Remote Sensing Applications to the Middle Atlantic Site Survey Form - Jay F. Custer, University of Delaware

2:15 PM - Some Site Survey Forms from New York State: Their Merits and Their Problems Ellie McDowell-Loudon, NYSU-Cortland

2:45 PM - A Summary of Cultural Resources and Environmental Variables of the Virginia Eastern Shore - J. Mark Wittkofski, Virginia Research Center for Archaeology

3:15 - 3:30 Break

3:30 PM - The Elk Island Tradition: An Early Woodland Regional Society in the Virginia Piedmont - L. Daniel Mouer, L. L. Lindberg, E. G. Johnson, and Robin L. Ryder, Virginia Commonwealth University

4:00 PM - Monocacy Regional Survey: A Comparison of Survey Methods and some Preliminary Results - Maureen Kavanagh, Maryland Geological Survey

4:30 PM - Underwater Site Survey Strategies: I-95 Tunnel under Baltimore Harbor - Daniel Koski-Karell, Karell Institute

SATURDAY MORNING

Historic Archaeology - Contributed Papers

9:00 AM - Lenape Settlement Patterns: Villages and Graveyards - Marshall Becker, West Chester State College

Indian Villages of the Maryland Lower Eastern Shore ca. 1660 - 1800 - Tom Davidson, Salisbury State College

Some Concepts for Intensive Analysis in Contract Archaeology: The Intermediate Level Contract - Ted Payne and Kenneth J. Basalik, Mid-Atlantic Archaeological Research Corporation

Investigating Pennsylvania's Provincial Frontier: The Archaeology of Fort Loudoun - Steven Warfel, William Penn Memorial Museum

Making Old Oysters Talk: New Insights on Oyster Usage in Colonial Maryland Brett Kent, University of Maryland

The Wilmington Boulevard Archaeological Mitigation Program: A Preliminary Report on the Fieldwork - Cara Wise, Soil Systems Incorporated

The "Roundabout" Road to Watt's Mill: Tenancy, Slavery, and Milling in 18th Century St. Mary's County, Maryland - Terrance W. Epperson, Maryland Geological Survey

10:30 - 10:40 Break

10:40 - 12:00 Noon - Investigating the Spatial Dimension of Historic Sites

Putting the Site into Context: The Archaeology of Land and Yardscape - Garry W. Stone, St. Mary's City Commission

"Among my other losses": Patterns of Material Culture in an Early 18th Century Manor House - Alice Guerrant, Delaware Division of Archaeology

Studying Site Patterns without excavation- Alexander H. Morrison, II, St. Mary's City Commission

Exploring 17th Century Spatial Organization and Use: A Prospectus - Henry M. Miller, St. Mary's City Commission

SATURDAY AFTERNOON

General Session

1:30 PM - The Excavation of the Stadt Huys Block: Methods and Procedures - Diana Rockman, New York University

2:00 PM - Site Losses not Federally-Covered: A Plan for Doing Something about them - Howard Mac Cord

2:30 PM - Towards Effective Management: A Cultural Resource Assessment of Maryland State Police and Division of Correction Properties in Maryland - Dan Meyer, Maryland Historical Trust

3:00 PM - Development of Physical and Climatic Parameters in the area of the Delaware Park Site since the end of the Pleistocene - Robert G. Doyle, Robert Doyle and Associates

3:30 PM - The Effect of Aeolian Processes on the Late Archaic Components at the Baldwin Site in Anne Arundel County, Maryland - Joseph M. McNamara, Maryland Geological Survey

4:00 PM - Archaeologically Significant Characteristics of Maryland and Pennsylvania Metarhyolites - R. Michael Stewart, Thunderbird Research Corporation

SUNDAY MORNING

Theoretical Concerns in the Middle Atlantic or New Directions in Archaeology

9:00 AM - Surface Collection, the Field Method for Investigation of Skunk Hollow, a 19th Century Free Black Community in Rural New Jersey - Joan H. Geismar

9:30 AM - An Ecologically Based Model for Fairfax County, Virginia, Prehistory - Michael Johnson

10:00 AM - Processual Theory and Archaeological Patterns: The Search for "Structure" in Historic and Prehistoric Archaeology - Russell Handsman

10:30 AM - 10:45 AM Break

10:45 AM - Archaeological Research Potential in the Mid-Atlantic Region - Stephen Perlman

11:15 AM - Site and Society: A Polite Assault on the"Gardner Method" - L. Daniel Mouer and Robin L. Ryder

11:45 AM - Surveying by Sattelite: A Preliminary Report on the Utility of the Multispectral Scanner aboard LANDSAT to Archaeological Surveying in Maryland - Peter Lade

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LET'S DO SOMETHING ABOUT SITE LOSSES!

While problems seem to permeate today's archeology, potential answers are also generally present. This paper outlines some of the needs, enumerates resources available for meeting those needs, and offers solutions for bringing the two together. Your comments and suggestions are welcome.

Though Virginia facts and figures will be used in this paper, the situations covered are not exclusive to Virginia. They exist to varying degrees in all states. Almost all would agree that too little is known about the past, both from a historical viewpoint and from a cultural processes viewpoint. Documentary sources are scant for much of the historical period, and of course lacking for the prehistoric period as well as for many segments of the historic population. Archeological sites, if properly studied, can supply much missing information. It is estimated that archeological sites in Virginia, for example, number at least one-half million. Answers to archeological questions can be found in some sites, but not all. A key problem is determining which sites contain those answers. Progress in finding, evaluating and studying sites is slow and expensive. Despite an upsurge in archeological efforts in recent years, a large percentage of sites have not yet been found, let alone studied.

Innumerable archeological sites are lost annually, most without being seen by an archeologist. Losses are due to construction, erosion, reforestation, changed farming methods, open pit mining, vandalism, and other causes, both natural and human. In Virginia this loss is estimated to be about 2000 sites per year. Current archeological agencies find and examine annually about 10% of these 2000 sites, primarily those on projects controlled or affected by Federal laws. Of the 200 sites found, fewer than 20 (10%) are excavated and/or studied. The remaining c. 1800 sites are largely on private lands and are rarely found or reported before being destroyed.

Simple logic states that archeologists should devote their attention (manpower and funds) to those sites which can add knowledge, regardless of where they might occur. The NEED, then, is for plans, procedures, and policies which ensure that ALL sites are found and evaluated. Most can be allowed to disappear without loss of important data. Sites found to be important should be protected, OR studied ahead of destruction. Implementing such policies requires that ALL land disturbances be seen by someone with the archeological know-how to recognize a site and to perform an initial screening for importance. Further, it requires a coordinated, state-wide effort by people dedicated to increasing knowledge, even if at some personal sacrifice.

The various state archeologists, regardless of title or position, with their staffs have responsibility to their public, their administrative or legislative superiors, and to their professional colleagues, for ALL archeological resources in the state or its waters. Regardless of the wording of job descriptions, they should feel this responsibility personally, acutely, and steadily. Since their attitudes and ideas influence other archeologists in the state, they should set the example for diligence, forcefulness, thrift, and understanding that will generate the most and best data for every dollar or man-hour expended. They should be the initiators of policies, the prime movers of projects, the defenders of resources, and the LEADERS of the archeological community's efforts. They should ensure that resources are not squandered on trivia. Further, they should mobilize people and resources of all types in the service of archeology and coordinate these to ensure that they are not wasted or alienated.

The variety of possible resources available in any state will vary, but in general they can be grouped, as follows:

1. STATE RESOURCES:

   a. Funding contained in the State's annual budget.
   b. Contingency funds, available to a Governor for emergencies such as imminent loss of an important site.
   c. Labor available from the State's penal system, usually at no cost.
   d. Equipment and labor of the State's highway department, for use on State owned property, and sometimes on private property, e.g. borrow pits and areas of indirect impact.
   e. Game and Fish wardens to report sites and to keep watch over known sites.
   f. State Police to watch for vandals on sites visible from highways.
   g. Use of State Park cabins as billets for archeological teams.
   h. State hospitals, prison camps, and other facilities providing meals.
   i. Other facilities and agencies, e.g. National Guard, Reserves, etc.

2. FEDERAL RESOURCES:

   a. Matching funds from various Departments and Agencies.
   b. Grants for specific projects or properties.
   c. Work relief programs.
   d. Military and Naval manpower and equipment on training missions.
   e. Military posts as sources of food, lodging, government surplus property, etc.
   f. Contracts on earth-disturbing projects.

3. LOCAL GOVERNMENTS:

   a. Appropriations for specific projects or to support research and surveys in their area sponsored by the State Archeological agency.
   b. Work relief programs, including vocational training programs.
   c. Earth moving and other equipment in various departments of local government, e.g. street and highways, parks, Civil Defense, fire fighting, etc.
   d. Local police to keep watch on known sites and buildings.

e. Use of school facilities for meals, storage, educational efforts, etc.
f. Hobby groups sponsored by parks and recreation agencies, including adult education classes.

4. ACADEMIC INSITUTIONS: (all levels)

a. Departments of Sociology, Anthropology, History, Geology, etc.
b. Anthropology, History, and other Clubs.
c. Adult education classes, credit and non-credit.
d. Field schools, including those sponsored and conducted by the State Archeological agency in conjunction with one or more educational institutions.
e. Physical facilities (lodging, meals, labs, storage, etc.)
f. Alumni donors who might support specific research projects.
g. Public and private museums, for storage, exhibits, labs, etc.

5. INDUSTRIES:

a. Equipment and skills of mining companies on sites adjacent to or on their lands.
b. Equipment and skills of pulp and paper companies, especially on reforestation land.
c. Construction equipment from contractors and dealers.
d. Services of architects, surveyors, soils and materials labs, etc.
e. Air photography by aviation companies.
f. Gifts of materials (e.g. bags, wire, plastic, lumber, etc.)

6. GENERAL PUBLIC: (Services to help find, test, protect, rescue sites)

a. Outdoors people, e.g. hunters, hikers, campers, Scouts, boaters, construction workers, etc.
b. Trained volunteer workers in all aspects of archeology.
c. Landowners who report, protect and help work on sites.
d. Donors of sites, funds, or bequests.
e. Civic groups who sponsor specific projects (Ruritans, Garden Clubs, etc.)
f. Local historical societies and foundations.
g. Hobby clubs.
h. Professional Societies and Clubs, e.g. engineers, lawyers.

Because of the wide-ranging nature of these resources, a most important job of the State agency is to identify resource people and enlist their help in carrying forward and supporting the needed archeological work. The State agency head should develop and lead these resources much as a conductor leads a symphony orchestra. He and his agency should carry out the following functions, enthusiastically and effectively:

1. Educate workers in archeology and the general public & legislators.
2. Inspire confidence, respect for the resources, and attitudes favorable to Science.
3. Stimulate action by groups and individuals.
4. Innovate in material ways, and in ideas and policies.
5. Publicize needs, people, efforts, results, & projected plans.
6. Curate finds and data derived from diverse work across State.
7. Encourage others to contribute their talents, time, and funds.

IDEAS FOR MOBILIZING AND USING RESOURCES FOR ARCHEOLOGICAL WORK:

1. Invite the PUBLIC, especially landowners, to report to the State agency all plans for disturbing land.

2. The State agency should have someone visit the land promptly and inspect the sites. Initial inspection should be done by a professional OR a dependable non-professional archeologist, AT NO COST TO THE LANDOWNER. This survey would be a public service--the first step in carrying out the agency's Statewide responsibility. Reported sites would then be evaluated by a professional archeologist, who would seek ways to protect the site OR to rescue the site data. The professional should be authorized to act for the State in mustering people and other resources for doing whatever is needed.

3. The above initial survey should generate minimal paperwork. Detailed studies into site ecology, history, and relationships would be part of any follow-up rescue operation, rather than part of the reconnaissance survey.

4. The professional archeologist should use volunteered (donated) labor, equipment and supplies to the maximum to keep costs down.

5. The State agency should provide needed conservation service, store excavated finds, and publish results of the work.

6. The State agency should have on-going contracts with local governments, industries, educational institutions, and non-governmental agencies and groups for the use of resources they can make available. A hands-off, arms-length attitude is not justified when close cooperation is so badly needed.

7. When legal constraints or moral persuasion result in funding for rescue work, the State should contract to do the work, using overhead moneys to help defray laboratory and other staff costs.

8. The State agency should sponsor field schools, with students coming from many jurisdictions and/or institutions. Training, logistic support and supervision would be provided by the State agency staff, with academic credits granted by each student's institution, under a cooperative agreement.

9. The State archeological staff should support and work closely with the state archeological society and with local historical and hobby groups, so as to know their capabilities and limitations.

SUMMARY: The State archeological agency should be less a regulatory/controlling agency and more a supportive, leadership service to the public, while at the same time conserving the archeological base and furthering knowledge.

IT NEEDS DOING!! IT CAN BE DONE!! IT MUST BE DONE!!

Howard A. MacCord, Sr.
Archeologist
Richmond, Virginia

MIDDLE ATLANTIC ARCHAEOLOGICAL CONFERENCE
OCEAN CITY, MARYLAND MARCH 20-22, 1981
SESSION: NEW TECHNIQUES IN ARCHAEOLOGY

SURVEYING BY SATELLITE: A PRELIMINARY REPORT ON THE UTILITY OF THE MULTISPECTRAL SCANNER ABOARD LANDSAT TO ARCHAEOLOGICAL SURVEYING IN MARYLAND*

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ABSTRACT

A new technique is suggested for the monitoring of management areas and archaeolpgical surveying in the state of Maryland. Through the use of a publicly available set of algorithms (ASTEP II) it is possible to classify and analyze the spectral characteristics of digitized data from orbiting Landsat satellites. Reported here is recent work conducted at Salisbury State College applying this technique to selected study areas. The results are discussed and compared to other sources of data, including U-2 overflight imagery and specially flown low-level aerial photography.

This paper is presented in an attempt to promote

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interest among archaeologists in the mid-Atlantic region in the use of remote sensing as an integral tool applicable to many surveying, management, and research concerns. Before discussing the experiments with satellite image processing at salisbury, a few prefatory remarks concerning the place of this work within the larger context of archaeological research methodology seem warranted. Satellite acquired data is only one of a variety of techniques for collecting data representing land form variations and their meaning. Collectively these techniques are referred to as remote sensing techniques. Although work with other sensors will be referred to briefly below, it is important to recognize that all current remote sensors measure some aspect of the electromagnetic spectrum. A review of techniques, equipment, and applications of remote sensing as they apply to the archaeologist may be obtained by referring to "Remote Sensing: A Handbook for Archeologists and Cultural Resource managers" (Lyons & Avery, 1977). In this paper i will focus primarily on the utility of data sensed very remotely - namely from space.

On July 23, 1972, the first in a series of satellites now designated Landsat was launched from Vandenburg Air Force Base in California. There are currently three satellites in orbit, although only two are actively transmitting data to Earth. Each landsat is wholly dedicated to acquiring Earth-resources data by means of two instruments. The first of these, and the one used most commonly, is a multispectral scanner (MSS) which measures reflected light from the Earth's surface in four separate bands of the electromagnetic spectrum. Two of these bands are in the visible portion of the spectrum, the remaining two in the infrared portion. The second instrument is a return beam vidicon (RBV) and is similar to a television camera. This device has not worked reliably in the past and little work has been done with rbv data to date.

Each Landsat satellite is in a circular, near-polar, sun-synchronous orbit so that any portion of the Earth's surface is scanned every eighteen days. Data is returned to one of several ground stations where it is recorded and interpreted. Soon thereafter, Landsat signals are further processed at Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, and converted into imagery or digital forms.

Imagery has the appearance of high-altitude aerial photography, and standard techniques of photo interpretation may be used to analyze the Landsat created scene. Digital data from Landsat are available on computer compatible tapes which permit the application of rigorous statistical techniques for more detailed analysis of the recorded light values.

Archaeologists have not used remotely sensed data as much as many other earth scientists. Most Landsat demonstration projects have been carried out by geographers and geologists (or specialists from allied fields) in conjunction with land cover mapping for forest and crop inventories, wildlife habitat mapping, flood damage assessment, geological mapping, and similar studies. The failure of archaeologists to take full advantage of remote sense technology in surveying and planning work is slowly being rectified. An excellent reference source is AERIAL REMOTE SENSING TECHNIQUES IN ARCHEOLOGY (Lyons and Hitchcock, 1977).

Among the compelling reasons for archaeologists to make better use of remotely sensed data, including landsat data, is that new methods for archaeological surveying and planning need to be developed in the face of rising costs and shrinking funds. There is also the need for more precise data than currently available in many areas of the mid--Atlantic to permit the formulation and testing of rigorous predictive and analytical archaeological models. One such new method, employing data provided by orbiting Earth satellites is described here.

The work being carried out at Salisbury derives its impetus from studies at Chaco Canyon, in the San Juan Basin of New Mexico. In that pioneering effort, carried out in the mid-1970's, remote sensing techniques, including Landsat analysis, were intensively evaluated for their archaeological potential (lyons, 1977). National Park Service archaeologists located and mapped approximately 400 miles of Anasazi roadways using both conventional and new remote sensing techniques (lyons, ebert, and hitchcock, 1976). Half of the road network was identified on the basis of archaeologically demonstrated occurrences; the other half by reference to maps produced by low and high level aerial photography in planimetric and oblique form. A map with this data was then

overlaid on a Landsat photo image which revealed that the major road branches lead to identifiable resource areas presumed to have also existed in the past.

Up to this point the Pueblo road system had been seen principally as a means by which interdependent communities were integrated. Now, however, through the use of Landsat and aerial photogrammetric evaluations, the road network can also be demonstrated to have been a necessary development providing reliable and easy access to vital resources located outside areas of primary occupation. For example, some branches of the network were shown to lead to timbered mountainous zones which may have provided wood and hunting, others lead to areas which may have served as possible sources of fish, and still others lead to locations which can be shown to be good sources of pottery clay.

In applying Landsat data analysis techniques developed for the Southwest to the investigation of archaeological sites in the mid-Atlantic region, new problems needed to be solved. Standing crops and forest canopies (such as are common in the Middle Atlantic region) prevent viewing the ground directly by satellite during much of the year. Urban and suburban development, man-induced alterations (such as strip-mining and reclamation), river dredging with associated spoil heaping, and effluent disposal mask or obliterate evidence of man's past cultural activities. Finally, even in ideal areas, sites are likely to be small and scattered, especially for the prehistoric period.

It is the purpose of this report to show how Landsat data may be used in the investigation of both large scale and small scale archaeological study units. Application of Landsat imagery to the definition of gross ecological zones has been described by Schalk and Lyons (1977) for the Southwest. It will be shown that similar work needs to be undertaken in the mid-Atlantic region. Recent work at Shenandoah National Park (Ebert and Gutierrez, in press) appears to be a major step in extending the Chaco experience to the Eastern Woodlands. Studies of this nature indicate that fixing the field of study well beyond the individual site effectively circumvents most of the problems associated with the interpretation of satellite data as noted by Ebert (1977), Lyons (1977) and others. However, as will be seen shortly, this occurs not without a significant loss of data

needed for potentially important research applications.

Utilizing this macro approach, it is possible to gain a synoptic overview of surface geology, topographic features, and soil differentiation. For example, non-linear patterns, including those of potential interest to archaeologists, may be detected. By using the derived reflectance characteristics of known geologic features it is possible to extract discernible patterns that have a high probability of being culturally significant from the total data set which would be expected to include naturally occurring arcuate and circular patterns. It is also possible to deduce paleo-sedimentation patterns from modern satellite derived analogs, to delineate large geologic lineament trends and smaller fault zones and to define larger rock alteration zones; all with reference to Landsat data. Such information has obvious importance to the study of prehistoric land form changes and the location of lithic sources used for tool manufacture. These data may also be tested against a model of resource exploitation and serve as a basis for an ecological approach toward the interpretation of past human activity.

The shortcomings inherent in this approach are, as suggested above, a product of scale. Site-specific information cannot be obtained and local variations within regional trends are easily lost. Nevertheless, the extensive experience of geographers and geologists may be drawn upon by the archaeologist in his attempt to incorporate land cover and geologic data in his work.

A second approach that would provide a solution to the problems posed by the dispersed nature of archaeological remains and the limitations of scale and resolution of satellite data is to focus on improved techniques of map registration and pixel analysis. This would necessitate acquiring computer software to reduce locational error to a five pixel field and to analyze the spectral characteristics of each pixel for each of the four spectral bands in considerable detail. Landsat data could then be used by the archaeological community for specific site location, critical area assessment, and temporal monitoring of selected areas of archaeological significance. Management of archaeological resources would also become practical on a regional or state-wide basis with the creation of detailed

computer-directed site inventories developed with the aid of analyses derived from Landsat data. Furthermore, these data would be sufficiently refined to permit inclusion in a systems model of cultural interpretation.

The remainder of this report will briefly present the results of very preliminary work completed at Salisbury State College and the Lower Delmarva Regional Center for Archaeological Research. The present efforts are directed toward integrating the efforts of the Department of Sociology and Anthropology and the Department of Geography and Regional Planning in implementing the integrated set of computer programs (ASTEP II) used for the processing of satellite data. The final objective of the work is to provide the archaeological community in Maryland with the operational capability to use satellite data for both research and functional resource management. Toward that end our work is being staged to allow testing of the programs and analysis techniques to be described below during the development and implementation of the Landsat analysis capability.

Use of the ASTEP II programs at Salisbury in the pursuit of a research objective involves a standard sequence of steps. It is first necessary to select an appropriate scene (available from EROS on standard tape reels recorded at 1600 bits per inch). Using the programs' data extraction routines, a subfield of specific interest is defined, deskewed, geocorrected, and scaled. For archaeological purposes it is desireable to focus on river drainage systems because these provide not only excellent topographic references for map registration, but also conform to a standard study unit for archaeological research. The Pocomoke River drainage system was selected as one of several test areas because supportive data from a variety of sources (aerial reconnaissance, soil maps, site records, collector reports, etc.) Could be acquired with existing resources.

A portion of this drainage is examined here to illustrate the techniques employed. The Landsat image selected was of a pass on April 9, 1978. Acquition of a black and white photo-like image showing the full Landsat scene is a useful method helpful in locating areas of interest. The full scene covers approximately 34,000 km with a ground resolution of 80 meters. Except for a cloud mass over the

Atlantic off Assateague Island, the scene is remarkably cloud-free. In order to develop computerized maps, a line-printer rendition of about one-fifth of the total scene was constructed from the same data. Without the smoothing capabilities of a video screen display, the scene loses some of its photo-like character. Further degradation occurs as the scale is decreased, especially on line-printer generated maps. These apparent losses in fidelity are mostly cosmetic, since all the data is retained.

The next step was to process a geometrically corrected view of a portion of the Pocomoke River. The first map so generaged reflects only data from the second infrared band which strongly differentiates between water and land and provides good haze penetration. Each of the symbols on the computer map represents a range, or slice, of reflected light values. Since water, given a blank as a symbol here, absorbs light in all wavelengths, areas of high moisture content are defined by the lowest values returned by the multispectral scanner. Likewise, dry sandy ridges, frequently associated with archaeological sites, have high reflectance properties and therefore return high spectral values.

More information contained within the data may be extracted by employing a variety of statistical techniques for pattern recognition. Figure 5 presents the results of a classification of pixels based on angular distance relationships observed in vector space of normalized data. One location suggested as a potential site by this computer run was confirmed by a ground check. Other locations will be walked in the near future.

The accuracy of maps generated from the satellite data must be evaluated by comparison to other sources of similar information that can be independently related to specific areas on the ground. This process of ground-truthing may be achieved in a variety of ways. The most obvious, but also the most time-consuming, of these is to walk the area. A more efficient, but less accurate, way is to overfly the study area by plane. This was done in August, 1980, for the study area. From an approximate altitude of 1,000 feet, photographs in color and color-infrared were taken at an oblique angle. It is, however, still difficult to relate a satellite map to the aerial photographs. A bridging platform is provided by NASA's high altitude aircraft. U-2

coverage at 60,000 feet was acquired for the study area, matched to the season of the Landsat overflight and the low-level overflight. Each frame of the U-2 coverage is a color infrared product which can be compared successfully at full scale to the Landsat maps and at enlarged scale to the low altitude aerial photographs.

Thus far discussion has largely been concerned with site identification and location. The development of strategies for resource management can also profit from the inclusion of Landsat data. Landsat analyses are among the most cost-effective for the production of thematic maps when applied to larger geographic areas. Landsat data may be used in several ways to facilitate the management of archaeological resources and are currently being incorporated into a management plan for lower Delmarva. The first of these ways of applying Landsat data to the management of archaeological resources is to provide uniform maps indicating the distribution and nature of archaeological and natural features. Monitoring the interaction between the two (the effect of erosion on sites, for example) and examining the relationship between site occurrence and topographic features is a primary goal. A second way is to allow for updating of the data base by acquiring data tapes from Landsat overflights at frequent intervals. A third way is to evaluate the effect of cultural stress (construction and land development) and natural stress (erosion and pollution) on archaeologically sensitive resources by computer analysis of Landsat digital imagery.

This report has tried to suggest a number of ways in which Landsat may provide data suitable for investigating specific research questions, management decisions, and site identification based on work being carried out at Salisbury, Maryland is in an ideal position to develop the Landsat program for archaeological application in the mid-Atlantic in that its academic institutions have a common computer capability. The landsat interpretative computer programs are accessible by all state colleges and universities as well as other state agencies such as the Dept of State Planning. Further, Maryland's varied landscape and archaeological record permit the testing of predictive models derived from satellite data. Future work in the Pocomoke drainage and elsewhere on the Eastern Shore by the Salisbury Regional

Center will attempt to contribute to the more general evaluation of this new technique.

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WILMINGTON BOULEVARD--MONROE STREET TO KING STREET

ARCHAEOLOGICAL MITIGATION PROGRAM

A Preliminary Report on the Fieldwork

Stewart

Cara L. Wise

Soil Systems, Inc.

Wilmington Cultural Resources Branch

Introduction

The Wilmington Boulevard--Monroe Street to King Street Archaeological Mitigation Program is currently being conducted by the Soil Systems, Inc. Wilmington, Delaware Cultural Resources Branch under a contract with the Delaware Department of Transportation. The purpose of this program is to mitigate the adverse effect which the construction of Wilmington Boulevard will have on archaeological deposits dating from the eighteenth, nineteenth, and twentieth centuries in center-city Wilmington. These deposits are contained within the Wilmington Boulevard Historic District. The current project covers only those resources which fall between Justison Street and King Street, a total of 7 half-blocks, to be affected by the first construction phase. The remaining portion of the historic district, comprising 4 half-blocks, will be investigated at a later time, as part of the second construction phase.

Clearly, the archaeological investigation of a large urban area like that to be affected by the construction of Wilmington Boulevard will contribute to the study of a wide variety of questions relating to the social and economic history of the city. Because of the strategic position of the Wilmington Boulevard Historic District, cross-cutting the core of the city, the study area is particularly conducive to the investigation of the effects of the related processes of urbanization and industrialization on population growth, settlement location, and the functional and social diversification of the inner city through 250 years of development. The following study topics were developed on the basis of this research problem:

1. Social change through time and space.
2. Settlement location through time and space.
3. Functional change through time and space.
4. Relationships between social change and settlement space.
5. Relationships between functional changes and settlement space.
6. Relationships between functional and social changes and settlement space.

In order to address these questions, a broad-based interdisciplinary study combining archaeological, social, and economic historical, and cultural geographical approaches is now underway. In the remainder of this paper, I will address myself primarily to the archaeological aspect of this research.

In order to investigate these study topics, it will be necessary to define and recover temporal, functional, and social indicators in good contextual relationships. These indicators include certain artifact categories and quantitative relationships among categories, faunal and floral materials, and soil chemical data. Contextual relationships include stratified deposits and subsurface features. Two levels of fieldwork and analysis have been defined in order to obtain this data.

In the first level of fieldwork and analysis, the links between behavioral patterns and archaeological data will be defined by partially excavating sites of documented age, function, and social class in order to isolate relevant indicators. The material recovered from these excavations will be analyzed using a variety of pattern recognition methodologies. Because most properties changed function through time, it has been necessary to maintain good stratigraphic control as well as feature separation.

In the second level of fieldwork and analysis, broader patterns of settlement location and social and functional site distribution over the study area as a whole will be defined. It was originally proposed that this information be gathered using auger samples, a technique which has been used successfully by Soil Systems, Inc., as well as others, in both rural and urban settings. However, it was found that because all the structures in the project area had been demolished before fieldwork began, demolition rubble covered the entire surface and prevented the use of an auger. Backhoe trenches were then cut along the line of the proposed auger transects, and standard volume samples taken from occupation levels at 10 ft. intervals and from features as encountered. The artifacts and other remains recovered from the samples will be analyzed in terms of the temporal, functional, and social indicators isolated as a result of the first level of fieldwork and analysis.

While it will be possible, and even necessary, for the demographic research to cover the project area as a whole, and even to look at the overall development of the city, cost and time limitations have made it necessary to select a sample of the properties within the project boundaries for excavation and detailed historical documentation. These properties, at least one on each block, were selected in order to retrieve the broadest range of information, in terms of time period, function, and socio-economic status. The fieldwork concentrated on rear yard areas because it was felt that the kinds of data needed to address the study questions would be most concentrated in these areas. The rest of this paper will consist of a brief description of the investigation of each of these lots, and the associated backhoe trenching. I will discuss each lot in the order excavated, so the stage numbers will not be in sequence.

Fieldwork

Stage 1 involved the excavation of one lot on the block between Tatnall Street and Orange Street. Preliminary documentary research indicated the presence, early in the eighteenth century, of a stream which appeared to have been filled by the beginning of the nineteenth century. Test excavations during the location/identification study, conducted by Mid-Atlantic Archaeological Research, Inc., had uncovered a cobble pavement and had located and removed several subsurface features, presumably privies. In developing an excavation strategy for this lot, it was assumed that undisturbed horizontal deposits existed under the pavement, and that stratified deposits might exist along the edge of the stream, although the draft report on the location/identification study did not address the question of such material. Subsequent excavation proved that although the western half of the lot had been removed to below the level of the original grade, undisturbed deposits did exist on the eastern half, and that stratified deposits existed along the eastern edge, as predicted. Because of the sequence of filling, the four privies uncovered were stratigraphically as well as spatially separated. Two of these privies dated from about 1800, a shell-filled trench dated from about 1835, one privy dated from about 1840, and a fourth dated from about 1850. A manure-filled pit contained material dating from about 1900. Part of the original topsoil had been covered with fill by about 1835, while the remaining western half remained open until about 1900, when the cobble pavement was installed. Because of changes in use through time, this property should provide information on late-eighteenth to early-nineteenth century middle-class domestic occupations and on nineteenth century residential/commercial occupations.

Stage 2 was located between Orange Street and Shipley Street. Documentary research indicated that in the eighteenth century, this block had largely been a marsh pasture. Although some stratified deposits were expected on the basis of the excavations for Stage 1, the location/identification study, which on this block consisted of the excavation of a single brick-lined privy, failed to indicate the scope of the problem. During backhoe trenching, subsoil was finally reached approximately 7 feet below the present level of Front Street. The original ground level consisted of highly organic soils characteristic of a marsh, approximately 2 feet thick. Over this there was up to 5 feet of clay and sand fill. The property excavated had been occupied by a cooper during the eighteenth century and later by his son, a cabinetmaker. Only two subsurface features were located on this lot, a brick-lined privy containing material dating from the late-nineteenth century, originating just under the present gound level, and a barrel-lined privy originating under the clay fill and dating from the end of the eighteenth century. Because of the depth of the deposits, it was necessary to excavate a series of terraces using a backhoe. The upper terrace was then excavated to the level of the second terrace, the second terrace was excavated to the level of the lower terrace, and the lower terrace was excavated to the watertable, approximately 7 feet below present grade. The occupation levels produced material dating from the mid- to late-eighteenth century and possibly the early-nineteenth century, and it appears that the clay fill was deposited over a very short period of time in the first quarter of the nineteenth century.

Backhoe trenching on Stage 6, located between Shipley Street and Market Street, proved to contain no intact deposits which could address the research design. The entire area had been disturbed by cellar holes, utility trenches, and holes dug to place and remove fuel tanks.

Two lots were excavated for Stage 7, located between Market Street and King Street. The northern lot had been occupied beginning soon after 1732 by members of one of the wealthier families in Wilmington. Test excavations conducted for the location/identification study had uncovered a brick pavement and had included the re-excavation of a privy looted by bottle collectors. Our excavations cut below the pavement into an intact eighteenth century occupation level. It appears that the pavement was placed during the first quarter of the nineteenth century. No defined subsurface features were found on this lot. The southern lot, consisting of a narrow strip between cellar walls, included stratified occupation levels and superimposed brick pavements. The earliest occupation on this lot also appears to have been early in the eighteenth century, although the socio-economic status of the occupants appears to have been much lower than that of the occupants of the northern lot. Next to the southern lot, trenching uncovered the only significant subsurface feature excavated on this block. This feature is a large, brick-lined structure, probably built as a cistern, but later used as a privy, and filled before 1824. This cistern produced a wide range of artifacts, including a vast array of organic materials not normally preserved. More than 100 reconstructable ceramic and glass vessels were recovered and await analysis, including matching porcelain tea bowls and saucers, dendritic pearlware vessels, an exceptionally elaborate lustre-decorated pitcher, bottles, and tumblers. Backhoe trenching through the remaining parts of the block indicated the presence of at least two occupation levels separated by fill.

Stage 3, like Stage 6, proved to have been too highly disturbed to contain deposits which could be used to address the research design. This stage was located between West Street and Tatnall Street.

The lot excavated for Stage 4, located between Washington Street and West Street, was chosen in the hopes of recovering information relating to the free black settlement which was located in this area in the late-eighteenth century and early-nineteenth century. The identification of stratified occupation levels in the backhoe trenches made this goal seem attainable, but only 3 of the 5 units excavated contained undisturbed deposits. Two of these were located over a streambed associated with a spring known to have been located on this block. Although some eighteenth-century artifacts were found in the organic soil filling this streambed, most of the material dated from the mid-nineteenth century, by which time the black inhabitants had been displaced by lower-class white residents. The bottom occupation level of the fifth unit could not be excavated because of weather and the depredations of construction equipment. Nonetheless, we have retrieved usable information on mid- to late-nineteenth century lower class white residential occupations from the stratified occupation levels and 3 1/2 privies excavated on this block.

Stage 5, located between Justison Street and Washington Street, also proved to be disappointing because there was too much disturbance. However, the information which we hoped to obtain from this block was recovered from Stage 4.

Conclusions

Despite the fact that three of the seven blocks included within the study area proved to be too disturbed to provide the information sought, these excavations along Front Street in Wilmington have produced a wealth of information in good contextual relationships that can be used to address at least some of the study questions. Furthermore, these excavations demonstrate the importance of looking at urban archaeological remains as total sites, rather than as a series of features and structures, as has so often been done in the past.

The analysis of the material recovered from these excavations is now being undertaken in our laboratory overlooking the Delaware River. Sophisticated computer programs are being developed to handle the complex manipulation of the vast array of historical and archaeological data that has been collected. We expect, at the very least, to be able to define patterns of artifact usage for several types of eighteenth and nineteenth century occupations, and to assess the use of backhoe trenching and sampling as a method of gathering a broad range of data in urban mitigation contexts. With the help of the demographic studies, we should also be able to address a broader range of the study topics presented at the beginning of this paper.

Stewart

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Field #1

GROSS MATERIAL TYPE

01 Ceramic

02 Glass

03 Metal

04 Leather

05 Wood

06 Bone

07 Fiber

08 Stone and stone products

09 Plastics or synthetics

98 Other

99 Unknown or indistinguishable

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramic

Field #2

GROSS FUNCTIONAL TYPE

01 Housewares

02 Other domestic

03 Construction

04 Industrial

98 Other

99 Unknown

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramic--Housewares

Field #3

SECONDARY MATERIAL TYPE

01 Porcelain

02 Stoneware

03 Earthenware

98 Other

99 Unknown or indistinguishable

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramic--Housewares

Field #4

DEGREE OF REFINEMENT

01 Fine

02 Coarse

99 Unknown or not distinguishable

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramic--Housewares

Field #5

01	White
11	Cream
21	Buff
31	Grey
41	Red
51	Brown
97	Other
98	Not applicable
99	Unknown or not distinguishable

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramics--Housewares

Field #6

BODY HARDNESS

PROPERLY FIRED

01 Hard-fired

02 Soft-fired

09 Unknown or indeterminate

IMPROPERLY FIRED

11 Over-fired

12 Under-fired

21 Burned

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramic--Housewares

Field #7

GLAZE TYPE

LEADGLAZES

01 Colorless

02 Blue-tinted (pearl)

03 Yellow-tinted (cream)

04 Green

05 Brown

06 Molasses or tortoiseshell

07 Black

21 Tinglaze

31 Saltglaze

41 Alkaline glaze

91 Unglazed

97 Other

98 Not applicable

99 Unknown or indeterminate

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramic--Housewares

Field #8

SURFACE DECORATION TYPE

01 Overglaze

02 Underglaze

03 Raised

97 Not applicable

98 Other

99 Unknown or indeterminate

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramics--Housewares

Field #9 and #10

SURFACE DECORATION TECHNIQUE

WET APPLICATION

TRANSFER-PRINTED

01 Lines and stipples

02 Stipples only

03 Lines only

09 Subtype not known or indeterminate

BRUSH PAINTED

11 Fine brush painted

12 Broad brush painted

13 Linear

OTHER WET APPLICATION

21 Stencilled

22 Dendritic

23 Sponged

24 Spattered

SLIP DECORATION

31 Combed

33 Trailed

35 Marbled

Field #9 and #10(continued)

38 Other

39 Unknown or indeterminate

RAISED DECORATION

41 Sprig moulded

42 Bat moulded

43 Slip cast

ENGINE-TURNED DECORATION

51 Linear

52 Scalloped

97 Other

98 Not applicable

99 Unknown or indeterminate

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramics--Housewares

Field #11 and #12

SURFACE DECORATION COLOR

01	Cobalt blue I
02	Cobalt blue II
03	Purple
04	Pink
05	Brown
06	Black
07	Yellow
08	Orange
09	Green
	LUSTRE COLORS
21	Pink
22	Copper
31	Polychrome
97	Other
98	Not applicable
99	Unknown or indeterminate

WILMINGTON BOULEVARD PROJECT

Preliminary Classification Scheme

Ceramics--Housewares

Other Proposed Fields

<u>Field #13</u>

VESSEL FORM

<u>Field #14</u>

BODY PART

<u>Field #15</u>

BODY PART FEATURES

Stewart

REMOTE SENSING APPLICATIONS
OF THE
SITE SURVEY FORM

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March 20 1981

Systematic approaches to recording data about both site and landscapes is shown to be useful for the prediction of Woodland and Archaic settlement patterns in a test area of New Castle County, Delaware. We propose that computer statistical techniques can be applied to large areas, large numbers of sites and large numbers of environmental variables to locate areas of high site probabilities. To test this hypothesis , an experiment has been carried out on a selected area along the Appoquinimink River in New Castle County. This methodololgy depends on consistent ways of recording site and environmental data.Over the past year the Department of Anthropology at the University of Delaware has been using the modified form presented by Bill Boyer and Bruce Kiracofe (1981) to record prehistoric site information. The Site Survey Forms provide the required consistent site data.The results of this experiment suggest that Landsat data combined possibly with digital terrain data can provide the necessary consistent synoptic analysis of the landscape.

The theoretical position from which this paper is derived is one of cultural ecology. We will assume that the limiting effects of the physical environment play an important role in the selection of loci for prehistoric habitation. However, these factors are not the only cause of variablity in the prehistoric settlement pattern record. Population densities , intergroup relations, and the requirements of trade and exchange play equally important roles in settlement selection choices. Nevertheless, given the state of knowledge of prehistoric lifeways in the Middle Atlantic, it is easiest for archaeologists to gain information about the environmental factors influencing settlement decisions. Models constructed on these environmental factors provide a valuable "first cut" at the data and allow the recognition of anomalies or "big surprises" (Binford 1972:111) in settlement patterns that the environmental models do not explain. Recogition of these anomalies allows the generation of hypotheses based on social factors that can be tested in future fieldwork. It is our contention that the cultural ecological approach, as translated into the Middle Atlantic Region by Gardner(1978) is the most efficient approach to these data.

We are developing a coherent methodology that analyzes a great number of environmental factors, relates them to mapped environmental factors and generates predictive maps with estimable error terms. This approach is similar to that of the Large Area Crop Inventory Experiment that predicts crop yields (MacDonald and Hall,1980) and the Uranium Resource Assessment Evaluation (Koch,etal 1981) that seeks to predict uranium reserves based on a multivariate model.

The methodology developed in the Appoquinimink experiment was

1. select predictive environmental variables .

2. Use a computer model to match known sites with the occurences of environmental variables throughout the test area.

3. Check the accuracy of the predictive map in the field and statistically examine all misclassified sites

4. Repeat steps one to three until desired accuracy is achieved.

1.0 SELECT PREDICTIVE VARIABLES

The first step in generating the methodology was the selection of the environmental variables that are important in predicting site locations. Previous experience in the Coastal Plain area (Gardner and Stewart 1978, Gardner 1978) and other studies in the Middle Atlantic which deal with specifying predictive variables using statistical analysis (Custer 1979,1980) have indicated that three basic variables have predictive value. These variables are surface water setting, geomorphic/topographic setting and soil setting. In other studies these variables were seen to be culturally relevant (Chenhall 1975:14) and subject to concomitant variation. As such they were deemed appropriate for the study of the Appoquinimink area. It should be noted that a special transformation of one of these variables, soil setting. was carried out for the Appoquinimink study. In earlier studies(Custer 1979,1980) the reasoning for including soil data was rather poorly developed. No explicit links were established between soil data and human choices. The potential relationships between behavior and the soil data are now seen as the result of the edaphic effects that soil series have upon plant community and ultimately animal community and distributions. USDA soil rating data for wildlife habitats were used to translate the soil series data into edaphic zones that would support any of two basic community types:openland setting and woodland settings.The existence of any given environmental type must be verified by the pollen or phytolith record and the rationale for applying the USDA ratings is presented elsewhere (Custer n.d.).

The Appoquinimink experiment has been carried out to evaluate whether LANDSAT derived classification can be used as input to a predictive model.The actual input used for our tests was land use classifications from the Newcastle County

Geographic data base - the Automated Environmental Resource Information System (Svatos, 1979). This greatly speeded up the testing time since the complex problem of extracting the relevant data from the LANDSAT imagery can be left until we know exactly what features to extract. LANDSAT imagery is routinely used to update such geographical data bases(Stow and Estes, 1981) This grid cell data base divides the county into over 55,000 500 foot by 500 foot cells. Associated with each cell is a series of variables that could be transformed to a point where they correspond to the enirionmental variables required for the predictive model. These transformations are described in section 6. A significant point about these variables is that they represent the distance to a certain environmental factor from each grid cell. This effectively takes into account some of the spatial nature of the environmental data. Topography is accounted for by a gradient term and a convexity term (Evans, 1972). Altitude itself and aspect were found to contribute no improvement in prediction to this model. Note that these latter parameters are not obtainable from LANDSAT imagery but are obtainable on digital terrain data tapes and can be merged with LANDSAT data (Stow and Estes, 1981).

2.0 THE PREDICTIVE MODEL.

The second step required the adoption of a mathmatical model to process this large amount of data and arrive at a reasonble prediction for all cells in the study area.

2.1 Assumptions

It was asssumed that site locations will be chosen to maximize the exploitation of critical resources. We make assumptions about the types of resources exploited and the maximum distance to these resources. However, unlike others we do not make assumptions about relative importance or mix of each resource. We are analyzing patterns in the landscape that are characteristic of preferable Woodland and/or Archaic sites. This approach to predicting sites attempts to parallel choices made by individuals on the ground who were also looking for preferable patterns in the landscape. The pattern that the model examines is that within 3500 feet of the cell.

2.2 The Statistical Model

The model is one that has been applied in geological research. In many ways the search for archaeological sites is similar to problems in mineral exploration(Zubrow and Harbaugh,1978). Both fields attempt to predict probablity of occurences based on erratically sampled, subjectively classified ,spatial multivariate data. A variety of statistical algorithms have been developed to process biased sample data on critical variables and generate probability distributions (Chung,1979) (Koch,Howarth,Schuenemeyer 1981). The logistic regression (Chung,1978) was the most appropriate model.

> " Logistic analysis may be used to estimate the probability that a given cell contains one or more deposits [sites]. The form of the model is
>
> y(i)=exp(x(i)*beta')/(1+exp(x(i)*beta')
>
> where y(i) is the probablity that cell i contains a deposit [site], x(i) is the multivariate observation in cell i and beta is a parameter vector which is usually estimated from a training set. The training set consists of a binary response variable indicating the presence or absence of a deposit[site] and a set of predictor variables such as stream-sediment data[distance to streams of various orders]."(Koch,Howarth, Schuenemeyer,1981:14)

Another advantage of this model over linear regression is the relaxation of the assumption of constant variance of the errors . (Chung,Agterberg,1979:4)

2.3 Training Set.

The data to be analyzed in this paper is derived form both controlled surveys and general site data in Appoquinimink drainage. A section of the drainage between the towns of Middletown and Odessa was subjected to a complete survey as part of the examination of a sewer-line right-of-way (Gardner and Stewart ,1978). This surveyed area plus some sites were used as the training set. A training set is anumber of cells where the probability of site occurence is known i.e. 0 or 1. This set of cells and their environmental variables is used to 'train' the computer model in the type of pattern to look for. The remainder of the area was not subjected to any controlled survey. It was thought that the complete survey made the Appoquinimink area a good test location for the testing of a synoptic predictive model. In all 150 cells were used in the training set, of these 17 contained sites.

2.4 Probabilty Map

The regression-calculated probability for each cell was printed on the computer terminal using the SYMAP package(Dougenik, Sheehan, 1976). These maps were printed at the scale of 1:50,000 so they could be overlaid on USGS topographical maps. The vertical scale(that is ,the probability of finding a site in this cell) was set so that all values greater than .2 are accented.

3.0 ANALYSIS OF RESULTS

The probability maps were compared to known sites used in the training sets, sites that had been held back from the analysis until this point, to randomly generated site locations and the training site probabilities were analyzed for their statistical validity. Field checks of the high probablity zones were carried out.

3.1 Field Checks

Three areas specified as high probability zones by the model had never been subjected to field survey. Of these three areas ,two were available for field survey during March 1981. A reconnaissance level survey was carried out at each area and a series of prehistoric sites were located in each area. No diagnostic artifacts were recovered, but fairly dense accumulations of fire-cracked rocks and debitage were encountered in both areas. The model is locating areas where sites are found. Note that this result does not imply that there are more sites here than than at a location predicted to be low probability. A systematic survey would be required to test this hypothesis.

More interesting were checks of areas which did contain sites, but were not predicted to contain them by the model. One case includes the Hell Island Site which is a large Middle Woodland base camp which has platform pipes and Jacks Reef pentalonal points. The Hell Island Site seems to be linked culturally and in time to the large cemetry at the Island Field Site. Using the predictive model presented here the Hell Island Site is in an area that would be classified as somewhat marginal. Using terminology noted by Binford (1972:111) the Hell Island Site is a "big surprise". However, it is no surprise that the location of large Middle Woodland sites which contain specialized artifact forms manufactured from "exotic" raw materials and which are linked to relatively complex mortuary ceremonialism are not completely explained by environmental variables. Additionally, it is important to note that although Hell Island was recognized as a special site (it is on the National Register) ,its "anomalous" location was not noted until the application of the predictive model.

3.2 Statistical Analysis Of Regression Output

Several measures were used to monitor the accuracy of the model.

> "While fit to the data is one useful criterion for evaluation of a model, we should not be preoccupied with obtaining the mathematically optimum fit (i.e. maximum adjusted r-squared or minimum residual standard deviation) to the estimation data. This point is particularly relevant when the model will be used primarily for prediction purposes." (Snee,1977)

Snee recommends the following procedures for checking the validity of a regression model:

1. Comparison of the model predictions and coefficients with physical theory

2. Collection of new data to check model predictions

3. Comparisons of results with theoretical models and simulated data.

4. Reservation of a portion of the available data to obtain an independent measure of the model prediction accuracy.

This model used coefficients that had been noted as predictor variables previously. The logistic regression automatically gives predictions in the range 0 to 1. We performed field checks to satisfy point 2. Point three could not be performed since no adequate theoretical models are yet available.To satisfy point four 13 out of 30 sites were held back for later evaluation.

3.2.1 F-Test -

The F-test for the regression tests the hypothesis that the variance about the regression line is no different than the variance in the observations. All model F-values exceeded the critical values at the 99% level of significance. That is the variance about the regression line was significantly different than the variance in the data implying there is a trend in the model.

3.2.2 Percentage Of Variance -

The model was explaining from 30 to 77% of the variance depending on the training sites used in the model.This measure is very sensitive to the choice of training sites but the other measures (RMSE,percentage of cells classified correctly) are not , suggesting that this particular variable should not be used as a reliable indicator of model accuracy.

3.2.3 Variability Accounted For In The Model. -

Variablity in cells can be calculated by the jack-knife method. (Chung, Agterberg,1979). Estimates of variablity in the factors were calculated by removing each factor in turn from the regression and noting the loss of percentage of variation explained.

3.2.4 Classification Of Cells -

Classification of predicted probablitiies into high probability (sites likely prsesent) or low probablity (likely no sites here) could be picked to achieve any predictive level desired. For instance if a cell is classified with y(i)=.01 and this wa deemed a high enough value to be "high probability", most of the map would be mapped as high probability. This area would likely include all known and yet to be found sites but too many cells would be included to make the map useable.

Therefore a value C was sought such that cells with y(i)<C would be classified "low probability" and cells with y(i)>=c would be deemed "high probability". A value C was decided upon that analyzed the training set and simultaneously maximized the percentage of known sites in the training set that were classified correctly and the percentage of known non-sites classified correctly. The appropriate value of C is .2. . This value maps 11.8% of the total area as high probablity. In terms of known sites and known-non sites in the training area, 58% (10 out of 17) known sites were classified as sites and 92% (123 out of 133) non-sites were correctly classified.

This information is summarized in the following confusion matrix:

For C=.2

	True Class	
	Site	Non-Site
Class Chosen		
Site	10	10
Non-Site	7	123

For C= .1

	True Class	
	Site	Non-Site
Class Chosen		
Site	14	99
Non-Site	3	34

Comparable statistics cannot be calculated outsite the training set because that area has not been completly surveyed.

3.2.5 Examination Of Other Known Sites In The Region -

Thirteen sites were not included in the training set. Three of these sites were in high probablity cells. Ten were not. The expected number of sites by chance alone would be 1.5 . However of these ten, three were adjacent to high probability cells(within 500 feet). The expected number of sites to be found by chance looking at adjacent sites would be about 4. These numbers are calculated from the percentage of high probability cells in the map. The increase in sites found using adjacent cells suggests spatial filtering (Goldberg, Goodenough,Shlien,1976) may be an appropriate technique to increase the accuracy of the model. Another way of analyzing these thirteen cells is to examine the Site Survey Forms describing them and look for patterns that may account for those ten misclassifications. It turns out that six of the sites are of unknown time period ,suggesting that only flakes were found and that this may have not been a habitation site. Perhaps all non-habitation sites should be classified separately. Unfortunately we did not have a large enough sample in our region to obtain statistical results to this question. Omitting the sites of unknown origin, produces four sites classified correctly and three sites classified incorrectly.

3.3 Comparisons With Randomly Generated Sites.

Tests were carried out to ensure that the model would not produce probability maps no matter what kinds of site locations were input .Twenty cells were randomly selected from the landscape using a table of random numbers to select the east and south grid cell coordinates. These twenty cells were input to the model as if they were the actual site locations.The model in this case failed to converge and could not yield any probability maps.This means the sites must be in some sort of a pattern to produce model output. The model is producing maps significantly different from chance.

3.4 Variability Of Factors

The model was run omitting each of the ten variables in turn. The decrease in fit of the regression was noted in each case and is recorded in Section 6 along with the description of each variable used in our model.

3.5 Source Of Errors

The results of this model are dependent on the choice of parameters.

> " There are several potential weaknesses associated with multivariate modeling including the large number of parameters that must be estimated...Most models assume multivariate normality and homogeneity of variance;these assumptions rarely hold...A major source of misclassification error is initial misclassification in the training set. For example, if certain occurence cells are classified as non-occurrence cells, then the actual misclassification-error rate may be appreciably higher than the apparent-error rate. ..Finally ,when models are applied to a virgin area , there
>
> is an assumption that the population parameters are the same as those in the training-set area" (Koch,Howarth,Schuenemeyer 1981:14)

This model depends heavily on the ways that the county decided tc classify certain landscape features such as stream order. LANDSAT classification should give us better control over this problem.

4.0 CONCLUSIONS

1. This particular model gives reasonable results . Sites were found in the areas that were classified as high probability. The model indicates more sites on the south side of the Appoquinimink than

the north side - this does appear to actually be the case. The accuracy of the predictive model seems to be adequate when the resolution of the predictions is given as 1000 feet, not the 500 feet of the input data.

2. A systematic appproach to recording site data combined with synoptic landscape analysis can produce predictive maps. The approach seems promising. The actual parameters used for this model are in no way meant to be the only parameters that could be used in such an approach. Parameters in other areas of the Middle Atlantic may be completly different.

3. This systematic approach presents the opportunity of testing hypotheses about what various factors actually were in site choice at various times.

4. This methodology offers a way of making statements about archaeological data over large areas. With larger areas the statistical significance of the data should improve since more site information can be brought into the model. Hay has suggested using a stratified sampling design with no less than fifty observations in order to test land-use map accuracy (Hay, 1979).

5. Site data forms are used for selecting input variables and for analyzing misclassified cells.

6. Insights into anomalous grid cells, such as Hell Island, can provide new information about these sites.

5.0 RECOMMENDATIONS

1. We recommend this methodology be pursued and extended to larger areas.

2. LANDSAT digital data should be classified and used as input to this method. The resolution is better than the AERI data base (cells are about 200 feet to a side), it should be more consistent and it is available over more parts of the country. The test area in the Appoquininink valley will be used to test the LANDSAT possibilities. LANDSAT color composites are superior to NASA high-altitude color IR "for discrimination of the slight tonal or chroma differences, especially for extensive regional overview" (Brown, Ebert, 1980:62). LANDSAT

can be used to map wetlands,rivers, lakes urban areas and even drainage characteristics (Kirschner et al,1978) and soil types (Wong, Thornburn, Khourg,1977).

3. Continued use of the Site Survey Form will allow more wide ranging analysis of settlement patterns than is now possible. This extension to the methodology will be simplified at the University of Delaware as soon as the ERDAS image processing system is operational. This system allows classification of LANDSAT imagery and overlaying and analysis of geographic data.

4. We recommend the development of a standard set of model accuracy measures so that various models, both numerical and intuitive ,can be compared in a standard manner. We recommend that at least the following be reported about each archaeological predictive model:

    1. Significance level of the F-value
    2. grid cell size used
    3. Confusion matrix showing classification of the training set.
    4. estimates of Variablity in data
    5. Results of input of random data
    6. Description of all factors used in the model
    7. estimates of the contribution of each factor to the predictive capablility
    8. classification results of any sites in the area that were held back from the original training set.
    9. percentage of cells classified as high probability in the entire region

5. As a standard method of storing and comparing Site Survey Form data, we recommend that they be stored in SPSS(Nie et al,1975) data files. We have available a computer card deck that initializes this data base for the Site Survey Form.

6.0 DESCRIPTION OF VARIABLES

The variables in our model are:

Note that all distances used in these variables are transformed using the following equation

distance=1.-(1./(-exp(x)))

where x is the distance to the specified zone. This was felt to represent a convenience-walking distance. This value is 0 for the category being available in this cell and rapidly approaches one for distance exceeding 3500 feet.

1. distance to closest minor stream

2. distance to closest major lake or resevoir

6 ~~3~~. distance to present day marsh - this is closely correlated with the actual floodplain .

3 ~~4~~. distance to edaphic soil type classified as openland(Custer,nd)

4 ~~5~~. gradient (Evans,1972)

5 ~~6~~. convexity(Evans,1972)

These are the contributions each factor made to the accuracy of the model

1. When this variable was removed the percentage of variation explained dropped from 72% to 50%

2. Variable two dropped to 42%

3. Variable 3 dropped to 51%

4. Variable 4 dropped to 51% also

5. Variable 5 dropped the variance explaines to 67%

6. Variable 6 appears to be the most influential as the percentage of variation explained was only 12% without this factor.

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